A Scranton Gillette Publication

MAY 1958

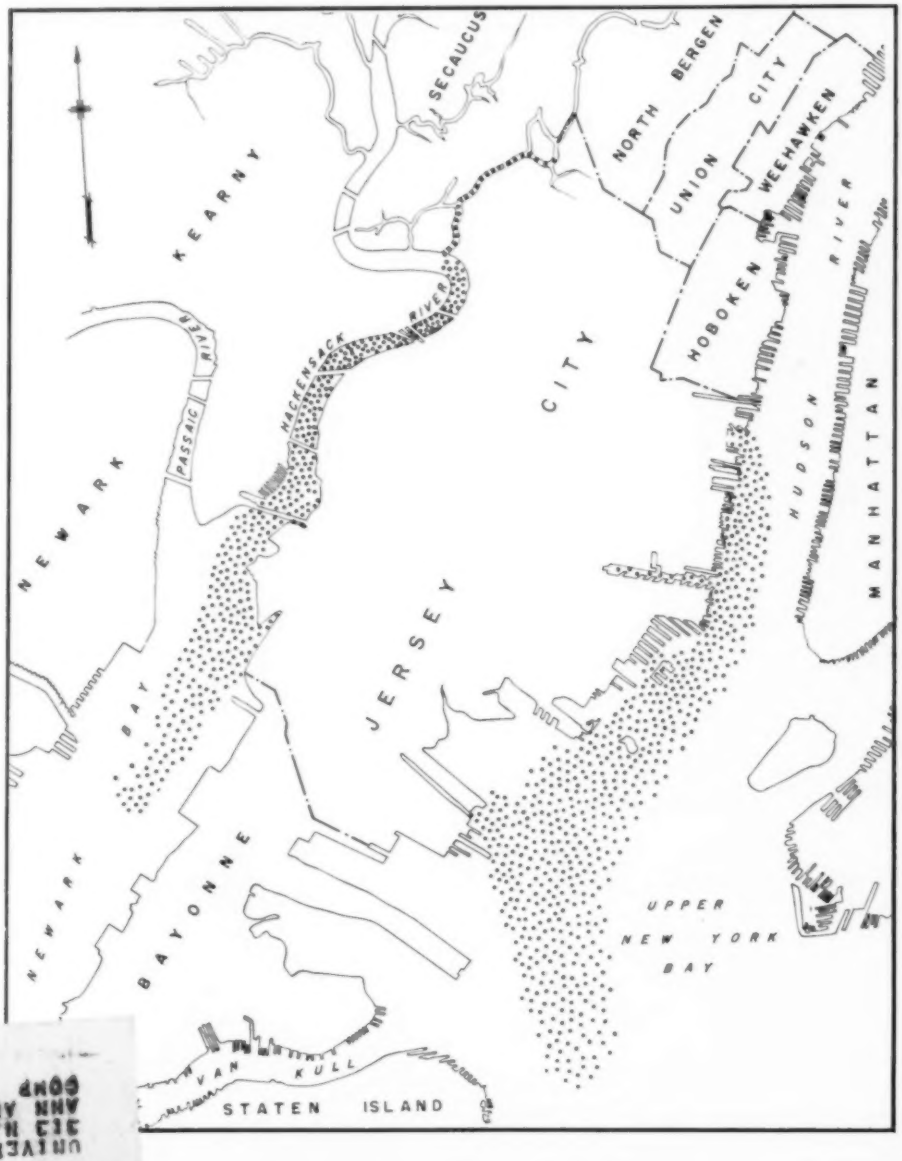
WATER & SEWAGE WORKS

WATER SUPPLY SEWAGE DISPOSAL

SEWAGE SOLIDS from Jersey City, N. J.

Each dot equals 100 lb dry solids per day—before treatment—

see p. 179



News — p. 7A

Equipment News — p. 11A

Bulletins — p. 27A

UNIVERSITY MICROFILMS
313 N. 1ST ST.
ANN ARBOR, MICH.
60MP

. . . with the greatest of ease

CUSTOMER

It fits in our budget with greatest of ease,
With savings at which no smart buyer can sneeze,
Low cost plus long life and best service he sees
Mean premium pipe at low pay.

CONSULTANT

It matches our plans with the greatest of ease,
Complete with bends, shorts, Y's, adapters and T's,
Designed for what pressure or backload we please,
The pipe we are proud to OK.

CONTRACTOR

It goes in the ground with the greatest of ease,
Is rapidly jointed come storm, heat or freeze,
No caulk, bolt or weld—installation's a breeze,
And backfilled the very same day.

OPERATOR

It carries full pressure with greatest of ease,
Corrosion and tubercles never displease,
High maintenance costs never put on the squeeze
With uncalled for bills to defray.

LOCK JOINT CONCRETE PRESSURE PIPE for this QUARTET!

CHORUS

It fills all our needs with the greatest of ease,
It's thrifty yet safe everybody agrees,
No wonder we all say, "No substitutes, please!"
When Lock Joint's the best pipe to lay.

LOCK JOINT PIPE CO.

East Orange, New Jersey

Sales Offices: Chicago, Ill. • Columbia, S. C. • Denver, Col. • Detroit, Mich.
Hartford, Conn. • Kansas City, Mo. • Perryman, Md.

Pressure • Water • Sewer • REINFORCED CONCRETE PIPE • Culvert • Subaqueous

HOW TO SELECT WATER-CONDITIONING EQUIPMENT (NO. 7 OF A SERIES)

*Water Impurities and Methods of Treatment**

HARDNESS *(Scale)* Calcium or magnesium salts such as bicarbonates, chlorides and sulfates	**Ion Exchange** (zeolite softeners). Generally used on clean, clear water to reduce hardness to a very low figure. Also avoids repumping. **Precipitator** (cold lime-soda softening). Used where turbidity, color or iron or manganese are also to be removed. Sometimes used for softening only—gives lower operating cost than ion exchange on high-carbonate-hardness waters. Reduces hardness to a few grains per gallon. Can be followed by zeolite softeners. **Hot-process Softener** (lime-and-soda process) usually followed by anthracite filter. Used for boiler feedwater. Also removes silica. Reduces hardness to a few grains per gallon. If followed by a zeolite softener (optional), no soda ash is used.
TURBIDITY Suspended dirt, sand, silt or other solids	**Sand Filter** (gravity or pressure type) alone . . . for water with moderately low turbidity content. **Precipitator** will reduce bulk of turbidity; generally followed by sand or anthracite filter for practically complete removal.
COLOR Dissolved or finely divided organic matter	A **Precipitator** with alum coagulant is generally used. Powdered activated carbon is sometimes added for further reduction of color. **Chlorination** may be used to kill living organic matter.
BAD TASTE OR ODOR Hydrogen sulfide (H_2S), cause of "rotten egg" odor	**Aeration** with several hours detention. **Adding chlorine:** Expensive except for removing small residuals. **Forced-draft degasifier:** Used if there are 10 or more ppm of H_2S or if CO_2 is also to be removed. **Carbon Purifier** (Carbo Dur®) or **Manganese Zeolite Filter:** For small volumes of water with 2 ppm or less H_2S.
Algae, organic matter	Same treatment as for COLOR. A **Carbon Purifier** may be used for small volumes of water . . . preceded by a sand filter if turbidity or debris is to be removed.
Excess chlorine	A **Carbon Purifier** provides simple, automatic operation. Also removes other causes of tastes and odors. **Sodium Sulfite** treatment reduces chlorine at lower equipment cost.
CORROSIVENESS Low pH due to free mineral acids	Neutralize with caustic soda, soda ash or lime.
Low pH due to carbon dioxide (CO_2)	**Aeration** reduces CO_2. A **forced-draft degasifier** removes practically all CO_2. **Neutralizing Amines** are used for corrosive hot condensate. Feeding **sodium silicate** will coat inside of pipes.
Alkalinity (carbonates and bicarbonates that form CO_2 under heat)	Can be reduced in a **Precipitator** with lime. Can also be removed by **Ion Exchange** (2 methods): Cation exchanger, sodium cycle, plus strongly basic anion exchanger, chloride cycle . . . for lower equipment cost on small flow rates, no handling of acids or alkalis, no blending of effluents. Cation exchanger, hydrogen cycle, then neutralization by blending with softened water or addition of caustic soda ("H and Na treatment") . . . for lower equipment cost on high flow rates and reduction of total solids.
IRON OR MANGANESE Ferrous or Manganous compounds (dissolved), bicarbonates, etc.	Up to 50 ppm of Fe can be removed with cation exchanger, sodium cycle—if water is clear and unaerated. **Aeration, raising** pH with lime, **settling** (in catch basin or Precipitator) and **filtering** will remove iron. If raw water pH is high enough to cause iron to precipitate on aerating, the lime or settling or both may be omitted. **Manganese Zeolite** ("oxidizing filter") for water with up to 2 ppm of iron or manganese.
Suspended iron (ferric hydroxide)	**Sand filter**—sometimes with a coagulant such as alum added just ahead of the filter.
SILICA *(Turbine blade scale)*	**Hot process softener** (and anthracite filter) for low and medium pressure boilers. **Ion exchange** (demineralizing) for more complete silica reduction for high pressure boilers.

***Factors in selecting specific treatments include:** initial or operating cost or space limitations, plans for future expansion, characteristics of raw water, desired effluent quality and volume . . . and degree of operating skill available (automatic vs. manual operation, facilities for routine chemical testing, etc.).

THE PERMUTIT COMPANY, Dept. W-5, 50 West 44th St., New York 36, N. Y.

PERMUTIT®
rhymes with "compute it"
a division of PFAUDLER PERMUTIT INC.
Water Conditioning
Ion Exchange • Industrial Waste Treatment

Most economical chlorinator for smaller water works, sewage plants. Safe, accurate, corrosion-resistant. Manual or semi-automatic. Capacities to 100 ppd.

Model 70C1610

All the features of larger chlorinators in a low cost floor mounting panel. Manual or semi-automatic. Capacities to 200 ppd.

Model 70C1110

Most popular, most flexible chlorinator available. Manual, semi-automatic, or automatic control. Capacities to 2000 ppd.

Model 70C2410

For the largest water, sewage treatment, and power plants. Manual, semi-automatic, or automatic control. Capacities to 8000 ppd.

Model 70C1510

There's an F & P CHLORINATOR for every need

Single well to major treatment works . . . the chlorinator *you* need is a Fischer & Porter Chlorinator. F & P developments have been incorporated in chlorinators covering the widest range of treatment requirements . . . from a fraction of a pound to 8000 pounds of chlorine per day.

Whichever F & P Chlorinator suits your needs best, you'll find it the most up to date unit available. For it's made by the same F & P engineers who have been responsible for every major improvement in chlorinator design in the past five years. This same group brought the corrosion-proof, diaphragm regulator, flowmeter type chlorinator to reality.

* * *

If you'd like to share in the benefits of advanced F & P chlorinator design, write now for complete details . . . and a list of installations. Visit any one of these and you'll see why so many users have found everything they were looking for in a Fischer & Porter Chlorinator. Write Fischer & Porter Company, 158 Fischer Rd., Hatboro, Pa. In Canada, write Fischer & Porter (Canada) Ltd., 2700 Jane Street, Toronto, Ontario.

FP

FISCHER & PORTER CO.

Instrumentation and Chlorination

Vol. 105 No. 5

May • 1958

A Scranton Gillette Publication

E. SCRANTON GILLETTE
Publisher

GEORGE E. SYMONS, *Ph.D.*
Editor

•

Editorial Associates
A. M. RAWN J. R. BAYLIS
C. E. KEEFER L. L. HEDGEPETH
H. P. ORLAND

•

CHICAGO OFFICE: 185 N. Wabash Av.
E. S. Gillette, Publisher
H. J. Conway, Adv. Ed.
W. W. Hamilton, Western Sales Mgr.
E. C. Heath, Sales Repr.
K. B. Quick, Subscription Mgr.

•

NEW YORK OFFICE: 155 East 44th St.
Editorial
George E. Symons, Editor
F. C. Maurer, Associate Editor
W. E. Becker, Asst. Editor

Business
T. M. Todres, Administrative Assistant
Evans J. Kall, Eastern Sales Mgr.
Wm. R. Joyce, Midwestern Sales Mgr.
Terence McCoy, Sales Rep.

•

85 Post Ave., San Francisco 4, Calif.
Duncan A. Scott & Co.
2978 Wilshire Blvd., Los Angeles 5, California
Duncan A. Scott & Co.

•

1201 Forest View Lane, Birmingham 9, Ala.
Fred W. Smith, Sales Rep.

•

Published and Copyrighted 1958 by Scranton Publishing Co., Inc.

•

Water & Sewage Works is published monthly with an extra issue in April. Subscriptions including the Reference and Data issue in the U.S. and Canada, 1 year $5.00; 2 years 7.50; 3 years $10.00. Other countries $1.50 per year additional. Single copies 50c except Reference and Data number $1.00.

E. Scranton Gillette, President; George E. Symons, Executive Vice President; C. T. Gillette, Secretary; and H. J. Conway, Treasurer.

•

Water & Sewage Works, Reg. U.S. Patent Off. Published monthly by Scranton Publishing Co., Inc., at 1600 N. Main St., Pontiac, Ill. Entered as second class matter at the post office at Pontiac, Ill., under Act of March 3, 1879.

WATER & SEWAGE WORKS

JERSEY CITY *pollution abatement facilities are described by* **David L. Gallagher** 179

WATER TANK MAINTENANCE *and its importance to management by* **Ken W. Altizer** 184

COLORED WATER—*red, black and blue by* **John J. Hamilton and Martin E. Flentje** 188

PRESSURE LOSSES *in water meters, a nomograph by* **D. S. Davis** 192

WATER *and other natural resources are discussed by* **Earnest Boyce** 193

AWWA *78th Convention* 196

CHLORINATION *of drinking water by* **Karl Imhoff** 197

WATER SUPPLY *problems in Nassau County, L. I., by* **W. Fred Welch** 199

CUSTOMERS RELATIONS *in water utilities are described by* **Thomas W. Moses** 201

COURTESY PAYS OFF, *a Dear Bill Letter* 203

OXYGEN DEMAND *of leaves in water by* **E. S. Chase and A. F. Ferrulo** 204

HYDRAULIC SLIDE RULE *by* **Joseph Tarrant** 206

CLOUD SEEDING: *Hope or Hoax by* **John A. Day** 207

THE UNIFLOW TANK, *Part I, by* **James L. Dallas** 210

BATTERY POWERED LOCOMOTIVES *for sewer tunneling by* **Robt. W. Hopewell** 216

DIGESTION CONTROL *with Gas Diffusion by* **P. F. Morgan and P. J. Neuspiel** 217

THE EDITOR'S COMMENTS 222

News—Here & There 7A
Equipment News 11A
New Bulletins 27A
Meeting Calendar 100A
News of Suppliers 104A
Helpful Free Literature 111A

Cleveland...

...uses Pratt Valves in a tight spot

City installations, with limited clearances and traffic problems, are never easy. This Cleveland project, tying a new booster station into two distribution lines, is about as tough as they come.

Here the specifications could not call only for "dependable valves" . . . it had to be "*dependable valves that are easy to install.*" This is where the engineer and contractor can tap the benefits of Pratt's long experience . . . major features of Pratt Butterfly Valves include exactly those things that simplify difficult jobs: minimum head room, versatile operators that can be buried without vaults . . . and design and construction such that the valve will always be easy to open or close.

If you would like to know more about Pratt Butterfly Valves, 40 page manual B2B is yours for the asking. *Henry Pratt Co., 2222 S. Halsted St., Chicago 8, Ill.* Representatives in principal cities.

See us in booth 134 at the A.W.W.A. Convention in Dallas, Texas; April 20-25

HENRY PRATT

RUBBER SEAT Butterfly Valves

Briefs

Jersey City pollution abatement facilities consist of two plants (east side and west side) with sludge from one plant being pumped to the other. The plants, now in operation about nine months are described—page 179.
Water Tank Maintenance is a responsibility of management which can decide whether or not money is to be wasted by proper planning and execution of operations—page 184.
Colored Water, either red, black, or blue, generally indicates corrosion and this article discusses causes and corrections—page 188.
Water as a Natural Resource needs efficient development which involves the extension of the principles of law to avoid many problems—page 193.
Chlorination practices in public water supplies in the United States set the practice which is being followed in Germany today—page 197.
Water Supply Problems in Nassau County, L. I., involve population growth, ground water surveys, and air conditioning among others—page 199.
Customer Relations can employ modern marketing techniques to solve difficult problems as is done at Indianapolis, Ind.—page 201.
Cloud Seeding as a method of producing rain is still a controversial subject and water supply people should know something about the theory in order not to be hoaxed—page 207.
The Uniflow Tank offers a new design of sedimentation tank based on fundamental concepts and experimental studies. (In two parts) Part I—page 210.
Digestion Control with gas diffusion is suggested and described as a method of maintaining high rate sewage sludge digestion—page 217.

Southeast Sect. AWWA Officers

elected at the annual meeting in Atlanta, Ga., on March 24, included: *Chairman*, John R. Bettis, Mgr. and Engr., Commission of Public Works, Charleston, S. C.; *Vice Chairman*, Lewis R. Simonton, Supt., Water & Sewage Treatment, Griffin, Ga.; *National Director*, Carl C. Lanford; *Secy.-Treas.*, N. M. de Jarnette, and *Trustees*, M. E. Henley and O. M. Fuller.

The Section also passed a Resolution of Regret for the death of Linn H. Enslow.

Edward Scott Hopkins

has announced the removal of his office for consulation services in Sanitary Engineering to 410 Professional Building, 330 N. Charles St., Baltimore 1, Md.

Philadelphia Sewage Sludge for N. J. Pine Barrens

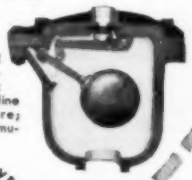
is under consideration by the New Jersey State Commissioners of Conservation and Economic Development, Agriculture and Health and representatives of the City of Philadelphia.

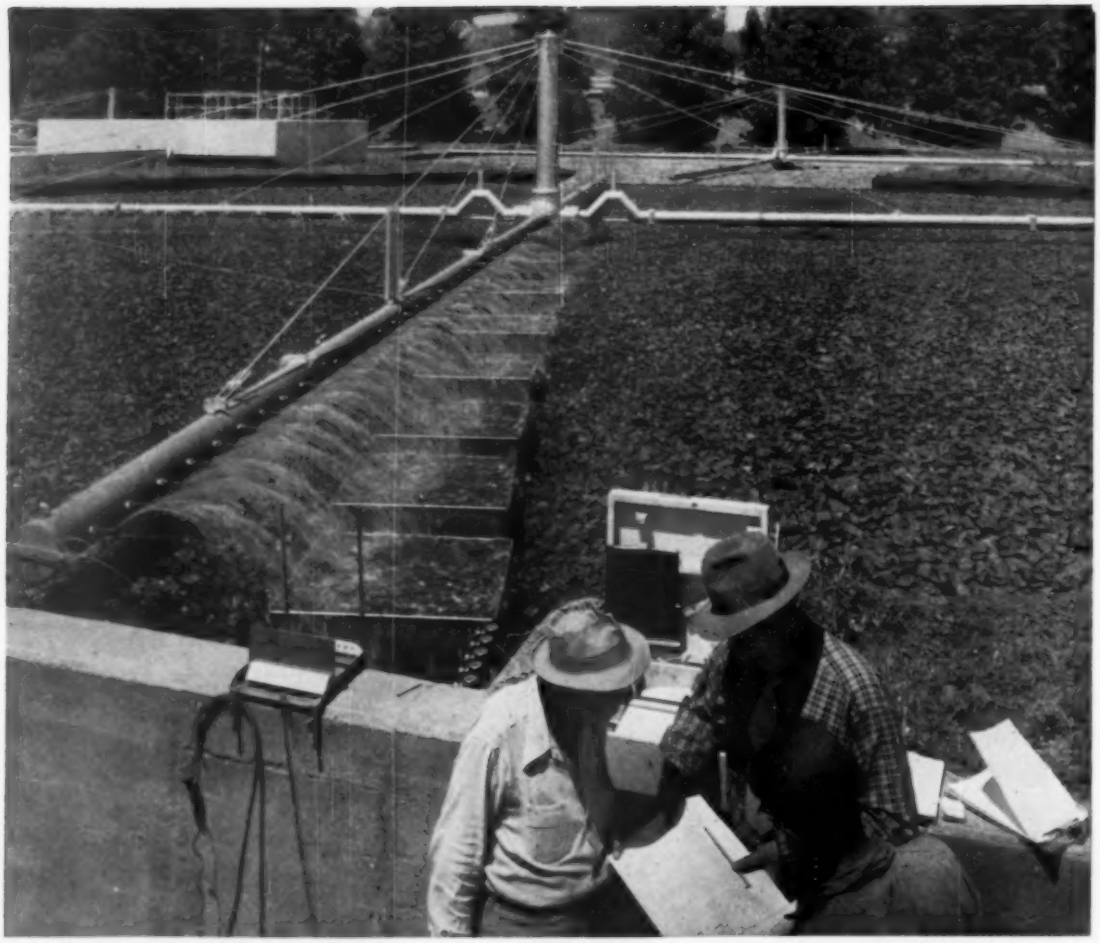
By next January, the City of Philadelphia will have the problem of disposing of nearly 20,000 tons of wet sludge a month. Current plans call for this sludge to be barged to 10 miles to sea—a round trip of 194 nautical miles. The cost of disposal will be approximately $212,000 a year.

An alternate plan, now under consideration is to haul the sludge a much shorter distance to the pine barrens of South Jersey as part of a long range soil conditioning program to develop New Jersey's waste land as farm land reserve for the future. Among the problems to be solved in this disposal scheme is that of effect of the sludge on ground and surface water supplies and possible odors.

Crispin
AIR VALVES
...keep pipelines open
for safe, economical operation
Simplified construction, easy accessibility, maximum durability and efficient cost-saving operation are basic in every Crispin Air Valve.

Crispin UNIVERSAL AIR VALVES ... positive, full-time air control when line is filled, in operation or emptied.

Crispin AIR & VACUUM VALVES ... permit air to escape as line fills, allow air to enter as line empties.

Crispin PRESSURE AIR VALVES ... provide automatic air escape while line is under pressure; prevent air accumulation in line.
Write, wire or phone for complete information on dependable Crispin Air Valves that keep your pipelines open for safe, economical operation.
AIR CONTROL VALVES FOR OVER 45 YEARS
multiplex
MANUFACTURING COMPANY
BERWICK, PENNSYLVANIA
Dept. B



Pan Tests being conducted on one of the 113' P.F.T. Distributors at Greenville, S.C. These tests show high uniformity of distribution over the entire range of flows—from 400 to 2100 gpm.

Proven uniformity of distribution with P.F.T. Rotary Distributors

Ten new P.F.T. Rotary Distributors have recently been installed in the Greenville, S.C. sewage disposal plant to increase the capacity of the existing filters. Six are 113 foot units and four are 136 feet in diameter.

All ten Distributors are equipped with P.F.T. automatic low-loss overflows on the two secondary arms. These overflows permit two arm-four arm operation and assure uniform distribution over the wide ranges of flow with a minimum of head.

These P.F.T. Distributors, with proven uniformity of distribution, are the heart of Greenville's expanded new treatment plant.

Plant addition by Wiedman and Singleton, Consulting Engineers, Atlanta.

Waste Treatment Equipment
Exclusively since 1893

P.F.T.

PACIFIC FLUSH TANK CO.
4241 Ravenswood Avenue
Chicago 13, Illinois

PORT CHESTER, N. Y. • SAN MATEO, CALIF. • CHARLOTTE, N. C. • JACKSONVILLE • DENVER

News----Here & There

Correction

to page 62 of the Feb. 1958 Number of *Water & Sewage Works.*—A. P. Jones, Asst. Sales Mgr., Consolidated Chemical Industries, Div. of Stauffer Chemical Co., Houston, Tex., has called attention to an error in the caption of Fig. 1 of the article on "Liquid Alum" authored by R. W. Ockershausen, Technical Service, General Chemical Div., Allied Chem. and Dye Corp. Mr. Ockershausen also called attention to the error, shortly after the article appeared. The caption as it appeared in the author's manuscript and in print accredited all of the liquid alum producing plants shown on the map to the General Chemical Division. Actually, the map shows the liquid alum producing plants of all producers in the United States and Canada. Herewith the map with the correct caption as supplied by the author.

FIG. 1—Principal liquid alum producing plants in the U.S. and Canada.

Dr. Raymond W. Hess

received a special award from the Manufacturing Chemists Assn. "in appreciation of his many years of dedicated service in the field of water pollution abatement." The occasion was a special luncheon in Washington, D. C. following the retirement of Dr. Hess as Coordinator of Pollution Research of the National Aniline Division of Allied Chem. & Dye Corp. in Buffalo, N. Y.

The award, an inscribed sterling silver tray was presented on behalf of MCA by L. W. Roznoy of the Celanese Corp., present chairman of the MCA's Water Pollution Abatement Committee. Looking on in the accompanying photograph is Gen. John E. Hull, USA (Ret.), MCA President.

Dr. Hess, an original member of that MCA Committee and a former chairman, is a Contributing Editor of Industrial Wastes. He plans to establish a consulting business in the field of water and waste treatment, in Buffalo.

Dr. Floyd W. Mohlman Retires

as Director of Laboratories of the Metropolitan Sanitary District of Greater Chicago, a position he had held since 1920. He was succeeded by E. Hurwitz, who has been associated with Dr. Mohlman for many years as Principal Sanitary Chemist of the Chicago Sanitary District.

Dr. Mohlman, who has been in ill health for the past few years received his graduate education at the University of Illinois where he was a member of the staff of the Illinois State Water Survey. Before going to Chicago he had worked with the Health Department in Connecticut.

Dr. Mohlman is a recognized authority throughout the world as a Sanitary Chemist and specialist in sewage and industrial waste treatment. He was Editor of Sewage Works Journal from 1930 until 1941 when the Federation reorganized and W. H. Wisely became Secretary-Editor. Dr. Mohlman continued as Advisory Editor of the Journal and still does. Dr. Mohlman is also known for his other activities in the Federation and has authored many articles in the technical press.

F. W. Mohlman

E. Hurwitz

Mr. Hurwitz is also an author of some note in the field of sewage treatment and industrial waste treatment. He has been acting as Director of Laboratories since the first of January of this year.

Cincinnati Inspects Sewers With TV Camera

that can be lowered sixty feet into the sewer to inspect and transmit back a picture to a 12-in. screen. This custom built television set cost $7,100 and is probably the first to be used for this purpose.

US RUBBER GIANT ACID HOSE

Keeping water soft during a tough plant-expansion job

The chemical treatment building of the Kansas City Water Works is getting a new addition. This big job will take two years, during which time the building contractor is using a simple and economical means for conveying water-softening chemicals to the water supply.

He uses chemically-resistant U.S. Giant® Acid Hose, furnished with stainless-steel fittings.

The men find it extremely flexible and easy to handle, resistant to abrasion, impact and weather. It remains unharmed by its highly corrosive cargo—hot lime slurry, ferric sulphate, alum solution, soda ash.

U.S. Giant Acid Hose is made for either suction or discharge service, replacing metal pipe because it handles highly corrosive solutions so well.

• • •

When you think of rubber, think of your "U.S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.

US RUBBER

Mechanical Goods Division

United States Rubber

Rockefeller Center, New York 20, N.Y.

In Canada: Dominion Rubber Company, Ltd.

News-Here & There

David L. Wright,

Sales Manager of the Badger Meter Manufacturing Co., Milwaukee, Wis., has been appointed as Advisor to the Director of the Water and Sewerage Industry and Utilities Division of the Business and Defense Services Administration, U. S. Dept. of Commerce. He is on loan from his company under a rotation system in which key business executives serve the Government without compensation for six

months or longer. He succeeds Charles K. Bassett, Vice Pres. of the Buffalo Meter Co., Buffalo, N. Y.

Mr. Wright was sworn in by H. B. McCoy, Administrator of BDSA. At the extreme right in the photograph are Walter L. Picton, Director, and C. K. Bassett, retiring Advisor.

1958 Penna. Clean Streams Conference

was held in Harrisburgh on Friday, April 18. The Conference (the 6th annual) was sponsored by the Pennsylvania State Chamber of Commerce with the cooperation of 18 other organizations. A feature of the program was a candid stock-taking of current progress in water pollution abatement by a panel of five. Moderator of the panel was Dr. B. A. Whisler, Head, Dept, of Civil Engineering, Penn State Univ.; the panelists included: Walter A. Lyon, Act. Dir., Div. of San. Eng., Dept. of Health, Harrisburg; L. L. Hedgepeth, Tech. Cons., Amer. Cyanamid Co., New York; William Voight, Jr., Exec. Dir., Penna. Fish Commission, Harrisburg, Dr. Richard D. Hoak, Senior Fellow, Mellon Institute, Pittsburgh.

The subject of air pollution was introduced for the first time on this year's program with a talk on "Sense and Nonsense about Air Pollution" by Harry C. Ballman, Mgr., Field Engr. Services, Bituminous Coal Inst.

Other speakers at the day long conference included: Dr. George E. Symons, Editor, *Water & Sewage Works,* New York, who spoke on Water Conservation; L. S. Hartley, Mgr. Agricultural Development, B&O Railroad, Baltimore; and Kenneth S. Watson, Consultant on Water Management and Waste Control, General Electric Co., Schenectady, N. Y. and current President of FSIWA.

Arrangements were made by the State Chamber's Pollution Abatement Committee headed by Howard T. Reuning, Supv. Wastes Engr., New York and Pennsylvania Co., Johnsonburg, Pa. Dr. George D. Beal, Director of Research, Mellon Institute, presided at the meeting.

Manhattan College

will offer a one-week course on "Theory and Design of Biological Waste Treatment" during the week of June 16, 1958.

The objective of the course is to present fundamentals of bio-oxidation which will serve as the framework for the analysis, design, and operation of waste treatment facilities. Emphasis will be placed on the application of these principles to pulp and paper wastes, and wastes from organic drugs, canning, and chemical industries. All correspondence concerning this course should be directed to W. Wesley Eckenfelder, Jr., Civ. Engr. Dept., Manhattan College, New York 71, N. Y.

Western N. Y. Water Operators Conference

held its annual meeting at Batavia, N. Y., on March 12. More than 200 water works men attended. The afternoon program was a panel presentation on water main cleaning and lining. Participants were: J. A. Frank, Vice Pres. National Water Main Cleaning Co., New York; Young Duhamel, Centriline Corp., Newark, N. J., and C. K. Knoener, Dist., Mgr. Pitometer Co., Albany.

The after dinner talk was given by Dr. George E. Symons, Editor, *Water & Sewage Works,* New York, who spoke on the past and future of the water works industry.

Officers elected included: Chairman, Duncan T. McNaughton, Dir. of Pub. Wks., Geneseo, N. Y.; Vice Chairman, Lewis B. Smith, Director, Water Bureau, City of Rochester, N. Y.; Secy.-Treas., Nelson B. Fuller, Supt., Water and Sewage Commission, Batavia, N. Y.

Water Use Data by Manufacturers

will now be collected for the calendar year of 1959, according to a statement released by Walter L. Picton, Director of the Wat. & Sew. Ind. and Util. Div. of BSDA.

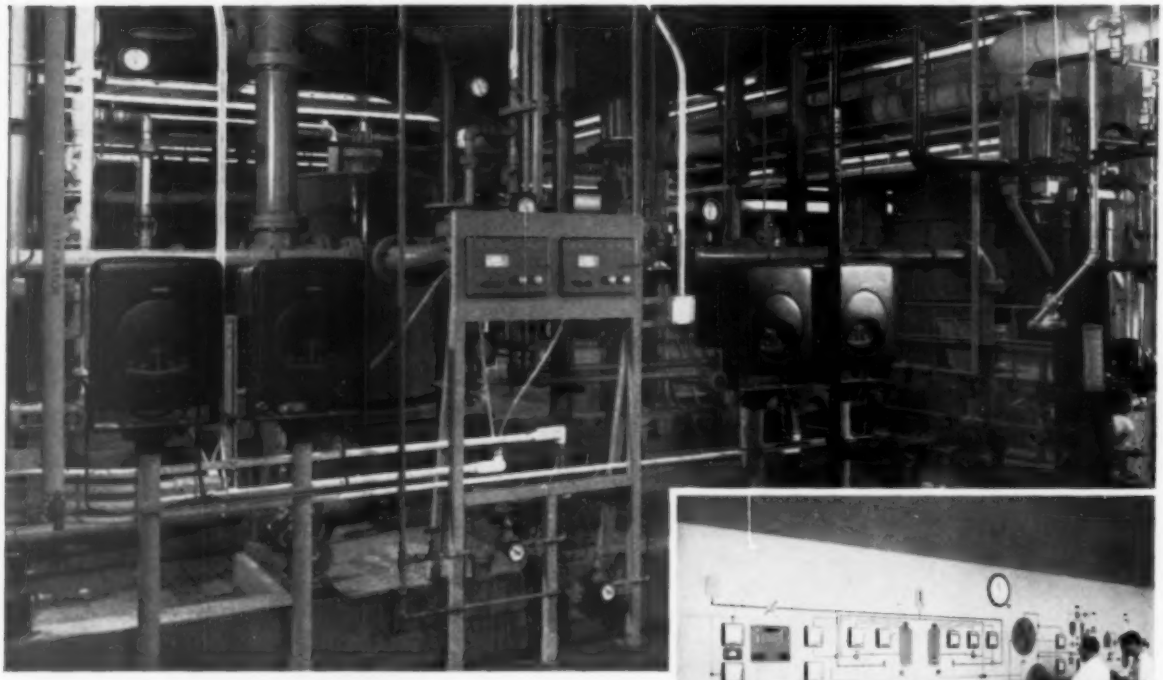
It had originally been planned to collect the data for the year 1958 as the Census of Manufacturers was taken, but these plans have been changed. A questionnaire will now be sent out to cover the year 1959. In order to assure essential periodic water use data collection, it has been recommended that the Bureau of Census incorporate into its permanent program for the 5-year census of manufacurers, a water use survey to be made in the year following each census.

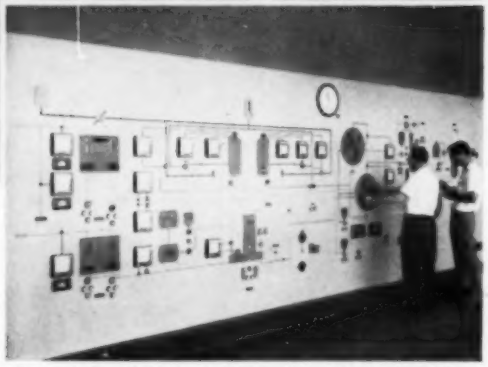
Chicago's Sanitary District Was Honored

by the presentation of a plaque from the ASCE at the ASCE meeting held in Chicago. The plaque commemorated the selection of the Chicago Sewage System as one of the seven engineering wonders of America. The selection for this honor was made by members of ASCE in 1955. The plaque is shown in the accompanying photograph.

at **BOEING**
Airplane Company...

• Four Foxboro Dynalog oxidation-reduction potential transmitters form the heart of this Chromate Waste Reduction System at Boeing Airplane Company. Dynalog instruments transmit pneumatic signal to remote control panel (below). Two Beckman pH Amplifiers can be seen in the center. Consulting engineers: Wilson & Company, Salina, Kansas.





Central Graphic Control Panel for Boeing's Industrial Waste Treatment Plant. Panel includes controllers for flow and liquid level of various tanks, as well as recorder-controllers for the Foxboro ORP meters.

TOXIC CHROMATE WASTE

is rendered harmless

using Foxboro continuous waste control system

At the Boeing plant in Wichita, Kansas, toxic hexavalent chromate waste from plating tanks must be reduced to trivalent chromium. Control of this complicated reduction process is handled by a Foxboro Continuous Waste Control System.

Four Foxboro ORP (oxidation-reduction potential) Meters are the heart of the system. These sensitive instruments take continuous ORP electronic measurements — pneumatically control addition of sulphur dioxide when oxidation potential starts to rise.

Simple or complex — waste treatment systems are everyday business for Foxboro. Years of experience, plus pace-setting instruments like the Foxboro Magnetic Flow Meter, the Foxboro Dynalog* Recorder, and the Foxboro ORP Recorder have made it possible.

Write us about your industrial waste treatment problem. We'll be glad to send you literature — or have an engineer call on you at your convenience. **The Foxboro Company, 895 Neponset Ave., Foxboro, Mass.**

*Reg. U. S. Pat. Off.

FOXBORO
REG. U.S. PAT. OFF.
WASTE CONTROL SYSTEMS

Equipment News

New Wash Trough For Filter Plants

501

F. B. Leopold Co., Inc., Zelienople, Pa., has introduced a new plastic wash trough for water filtration plants that offers a number of important advantages.

This unique trough is made of fiberglas-reinforced polyesterlaminate plastic—a material that is especially suitable for wash water troughs. It's corrosion resistant, light in weight, durable, easy to handle, has a smooth

hard surface, and resists all kinds of weather. In addition, it is inexpensive to install, never needs painting, and will last indefinitely.

In the Leopold construction, the glass mat is extra heavy to provide added strength. Plastic or stainless steel cross braces are provided for maximum rigidity and strength. All fasteners or supports are stainless steel or plastic, so they can't rust or corrode. Of particular note: sand stops are an integral part of the trough and the weir edges are mold-formed, thus eliminating the job of field grinding. Adjustable weir troughs are available as an optional feature.

This new trough can be supplied in a number of cross-sectional dimensions, providing capacities to suit any requirement.

Plastic Lightweight Dall Flow Tube

502

Builders-Providence, Inc., a division of B-I-F Industries, Inc., Providence, R. I., has developed a compact, plastic, insert-type Dall Flow Tube, Model DFT-PI. It is made of epoxy or polyester resins, reinforced with fiberglas, with corrosion-resistant metallic throat-ring and flange. This flexible differential producer is ideally suited for metering ordinary liquids, gases, and even such "difficult" fluids as acids, alkalies, and slurries, with very low head loss and consequent reduced pumping cost.

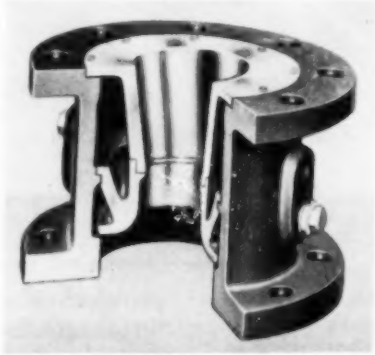
The Model DFT-PI fits between pipe flanges, and its extremely short length and light weight make it especially easy to install. Accuracy is within ±1% of actual flow rate for uncalibrated units, and can be increased to ±½% by laboratory calibration. Standard models are available with a variety of metallic materials, and for pH from 0.2 to 10. Temperature ranges are from —60°F to 220°F.

New Type Venturi

503

Infilco, Inc., Tucson, Arizona, has developed a Twin-Throat Venturi, the new Venturi is said to produce higher differential pressure or lower head loss in a much shorter laying length than other types. Applications include metering of water, sewage, air and other fluids and gases.

The new Twin-Throat-Venturi is basically simple in principle. The low pressure is taken from a hydraulically-streamlined body instead of from a

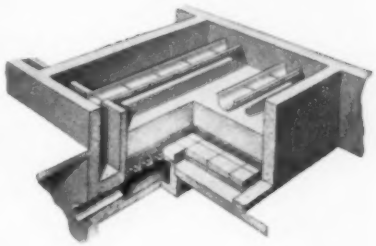


wall. This body is placed in the center of the narrowest cross-section, at a point at which the pressure is further lowered by the locally increased velocities around it. By such an arrangement a higher differential is obtained without materially changing the energy conversion in the tube, while the head loss remains practically the same.

Thus, by selecting a proper area ratio, the larger differential is obtained without increasing the loss. By choos-

CONTINUED ON PAGE 13A

Only
Leopold
GLAZED TILE
FILTER BOTTOMS
Successfully meet all underdrain requirements



Filter unit showing Leopold Filter Bottom and Leopold Fiberglass-Reinforced Plastic Wash Troughs

Performance Proved in over 375 plants with a daily capacity of more than 2¾ billion gallons!

In this design, laterals and distributing blocks form a permanent unit that assures equal filtration and uniform wash distribution with low loss of head. Made of de-aired fire clay—vitrified and salt glazed—the blocks can't corrode, won't absorb water, are acid and alkali resistant, and are not subject to tuberculation.

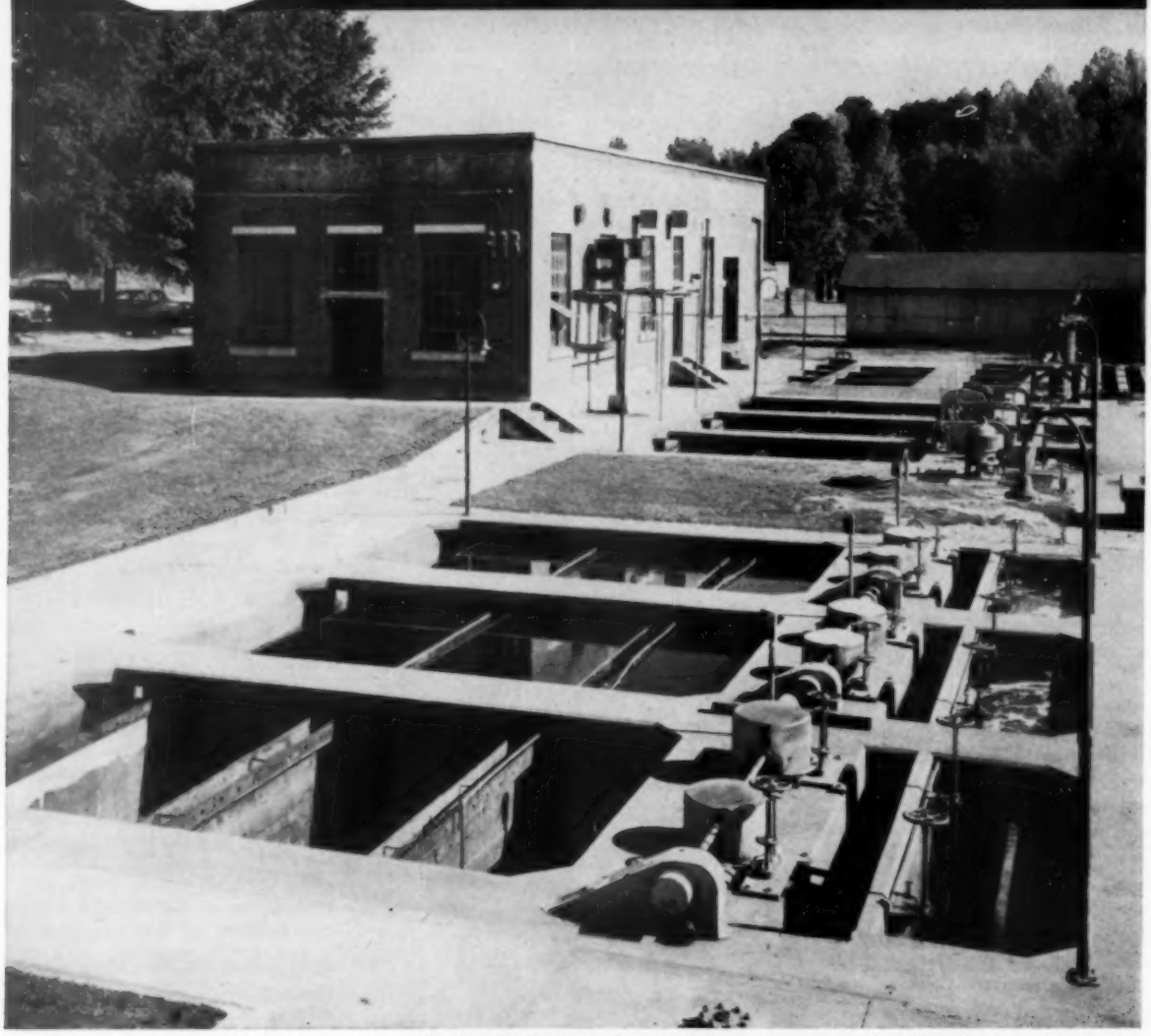
In addition, the Leopold Filter Bottom needs only a shallow depth of small-sized filter gravel, does not require supporting concrete structures, and is the only design providing a fixed and controlled secondary backwash.

Literature and Complete Details Furnished on Request!

Leopold
F. B. LEOPOLD CO., INC.
Zelienople, Pa.

COMPLETE WATER PURIFICATION AND FILTER PLANT EQUIPMENT

REX VERTI-FLO CLARIFIER solves plant overload problem



Rex Verti-Flo Clarifier in Gastonia, N.C., sewage treatment plant. Walter Gardner, plant chemist.

With the aid of Rex Verti-Flo Clarifiers, the city of Gastonia, North Carolina, substantially increased the capacity of its sewage treatment plant *without increasing the plant size*... solved the problem of a badly overloaded plant. Installed in the existing settling tanks, Verti-Flo provided the increased capacity needed... at low cost. Here's why!

Rex Verti-Flo Clarifier divides the conventional horizontal-flow settling basin into a series of individual vertical-flow cells. Through a unique combination of wood partitioning baffles and adjustable V-notched weirs entirely around the periphery of each cell, tank capacity is tremendously increased. Installed in existing tanks, Rex Verti-Flo Clarifier will at least *double the present capacity*... and provide a far clearer effluent.

The adjustable weirs control the draw-off within each cell so that full advantage is taken of the generous weir length. Inlet, distribution, vertical and weir velocities are extremely low and carefully controlled ...assuring most suitable settling conditions. There is no short-circuiting between cells and flow is completely balanced throughout the tank and among the cells.

If you have an overload problem in your plant or want to assure maximum capacity for a new plant, investigate the advantages of Rex Verti-Flo Clarifier.

For complete details, write CHAIN Belt Company, 4610 W. Greenfield Ave., Milwaukee 1, Wisconsin.

CHAIN BELT

Equipment News

CONTINUED FROM PAGE 11A

ing a larger area ratio, the head loss is smaller. Measuring accuracy is not impaired.

Magnetic Flow Meter for Half-Inch Lines

504

The Foxboro Co., Foxboro, Mass., has announced that the magnetic flow meters, previously limited to a minimum line size of 1-inch, is now available for ½-inch flow lines. It will be particularly useful in ratio flow control systems where small flows are ratioed to larger ones.

The smaller meter offers the full advantages of the larger instruments; namely, over-all accuracy of 1 per cent of full scales throughout the entire scale, no restriction of flow, linear flow readings, and performance unaffected by pressure, viscosity, density or changes in conductivity of the flowing liquid.

The transmitter unit consists of a Teflon-insulated non-magnetic flow tube containing flush-mounted metallic electrodes and surrounded by an a.c. electromagnet. When a conductive liquid passes through the tube, an alternating voltage is set up between the electrodes which varies linearly in proportion to the volume rate of flow. Lead wires from the electrodes transmit this voltage output to a Foxboro Dynalog Recorder, producing a chart record in appropriate units of flow.

Flow rates as low as 3 gpm can be measured by the new instrument.

Durable Belt Weigher

505

Omega Machine Co., a division of B-I-F Industries, Inc., of Providence, R. I., has announced a new Belt (Stream) Weigher. Known as the Pneu-Weigh, this advanced unit meets the needs of continuous process industries for measurement and control of flow of dry materials at low to medium rates from 0 to 3000 lbs per minute.

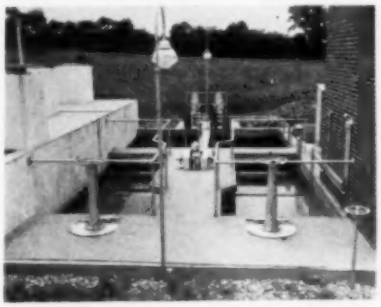
The Pneu-Weigh operates over a 10:1 range, which can be converted to 50:1 by the Omega Variable Speed Belt Drive. Its accuracy is held within plus or minus ½ per cent of the maximum rate. Design is rugged and dependable throughout, featuring positive chain drive to eliminate slippage, and continuous integration which totalizes correctly regardless of belt speed.

Uniflow Settling Tanks

506

Link-Belt Co., Chicago, Ill., has announced an improved settling tank design, the Uniflow Settling Tank, for removal of solids from water, sewage and industrial wastes.

The Uniflow Tank combines a rapid sloping bottom with multiple effluent weirs. This advanced design increases



efficiency of solids removal, offers economical construction, and as the name Uniflow implies, maintains the velocity of liquid throughout the tank at as nearly uniform a rate as practical tank construction allows. Link-Belt Straightline sludge collectors provide positive removal of scum from the surface of the liquid and sludge from the bottom of the tank.

Plywood-Molded Pipe

507

Plycraft, Inc., Lawrence, Mass., has developed a new plywood-molded pipe that can be produced economically in any diameter, and lined with any type of material to fit the requirements of any job.

This important plywood pipe development, produced after many years in the research stage, offers many advantages over pipes made of conventional materials, including composition, cast iron, steel and plastic.

According to the company, Plycrafts extremely versatile new plywood pipe is non-corrosive. Contrary to the popular belief that metal-type pipes are more durable than wood, Plycraft's specially-treated plywood has a longer life than metal, and most

CONTINUED ON PAGE 19A

HEAVY-DUTY
ELLIS PIPE CUTTER
FOR CUTTING LARGE SIZE PIPE

Drop-Forged Frame and Links
Long-Lasting Cutter Wheels
Makes a Hit With Water Works Men
Cuts Pipe in or Out of Ditch

TWO SIZES
No. 01 for 4" to 8" Pipe
No. 1 for 4" to 12" Pipe

Write for Circular and Price List No. 40WS

ELLIS & FORD MFG. CO.
FERNDALE 20, MICH.

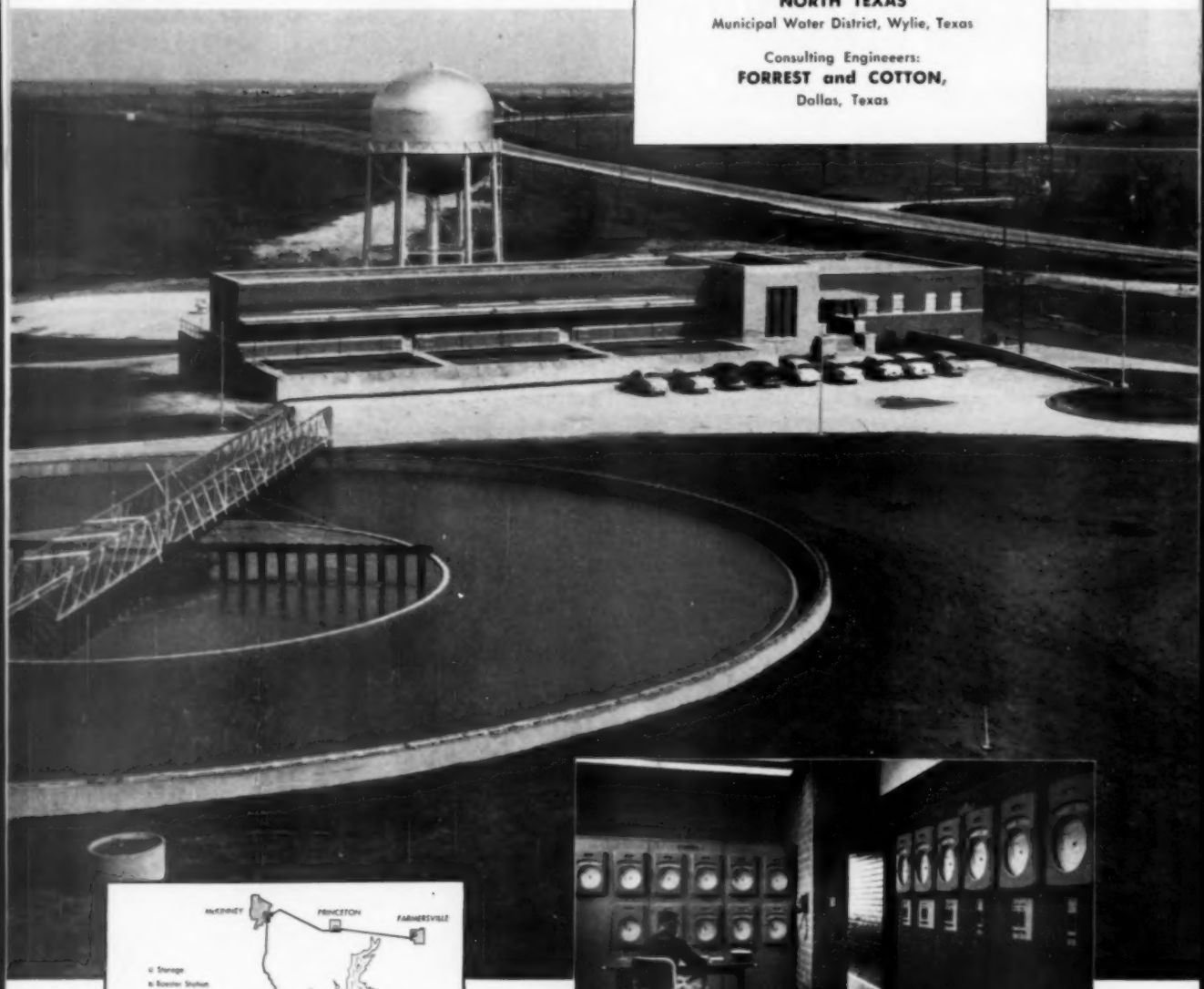
Surer Gland Lubrication for Centrifugal Pumps

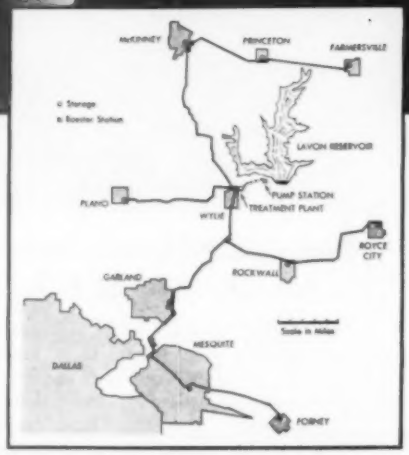
THE Z-F GREASE SEAL eliminates that trouble spot where shaft enters casing. Applies constant positive lubrication to packing and shaft—automatically. Excessive heat, rapid wear, leakage and scoring will disappear as the Grease Seal applies a constant flow of lubrication when pump starts until it stops—automatically. Many other advantages, too. Write for complete description and price. **ZIMMER and FRANCESCON, Moline, Illinois.**

ZF

NORTH TEXAS
Municipal Water District, Wylie, Texas

Consulting Engineeers:
FORREST and COTTON,
Dallas, Texas



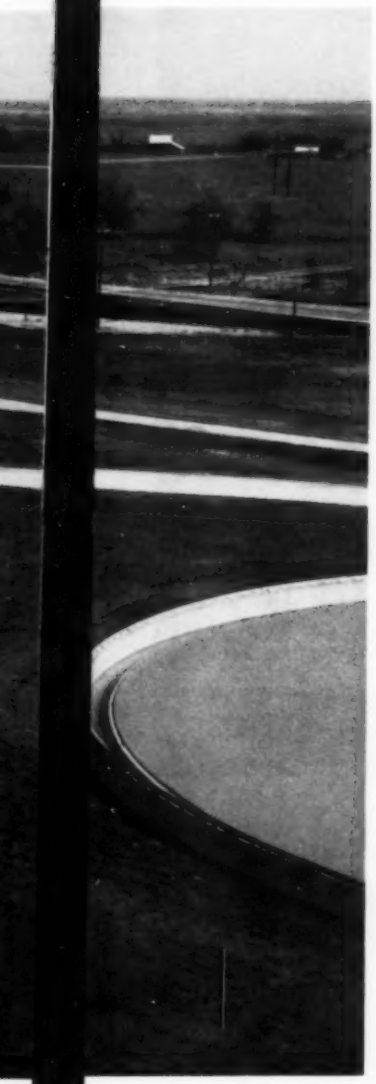


TEN MEMBER CITIES, with the City of Dallas as a customer, are efficiently and economically supplied with water taken from the Lavon Reservoir, treated at the Wylie plant, and fed out over the 92.4-mile network.

BUILDERS-PROVIDENCE CENTRAL CONTROL and telemetering panel at Wylie controls operation of pumps and valves in all three directions . . . using only two telephone circuits. This Synchro-Scan® feature effectively reduces monthly rates.

ONE SOURCE
ONE RESPONSIBILITY

BUILDERS-PROVIDENCE
DIVISION OF
B-I-F INDUSTRIES
METERS
FEEDERS
CONTROLS



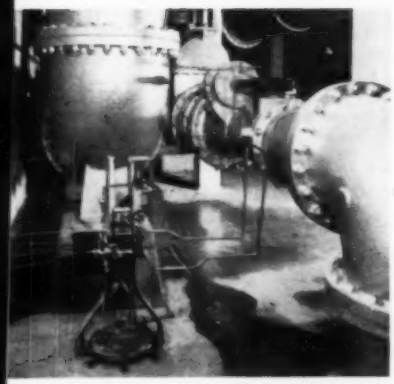
CONTROLS AND EQUIPMENT FOR TEN-CITY WATER SYSTEM SUPPLIED BY ONE MANUFACTURER

Builders-Providence given full responsibility for Controls on New $7,000,000 North Texas Municipal Water Treatment System

Selecting equipment and controls for an operation spreading over four separate counties is a major undertaking. A decisive factor in the choice of Builders-Providence was the ability and experience of this *one company* in supplying all equipment needed for telemetering and supervisory control, filter control, chemical feeding, and related functions.

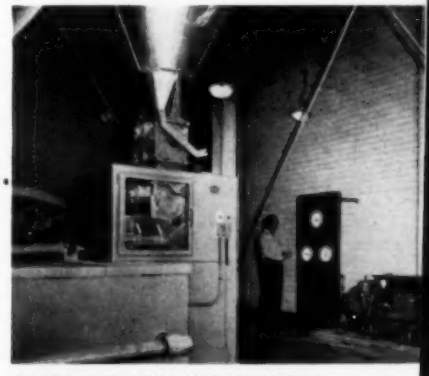
ONE SOURCE — ONE RESPONSIBILITY integration permitted one field engineer to coordinate the installation and start-up of the entire system . . . centering full responsibility for its efficient operation. The result: better coordination, minimum installation costs, and greater systems reliability!

Save time, save money . . . with a single, responsible source . . . offering nation-wide sales and service through local offices. Write **Builders-Providence, Inc., 350 Harris Avenue, Providence 1, R. I.**

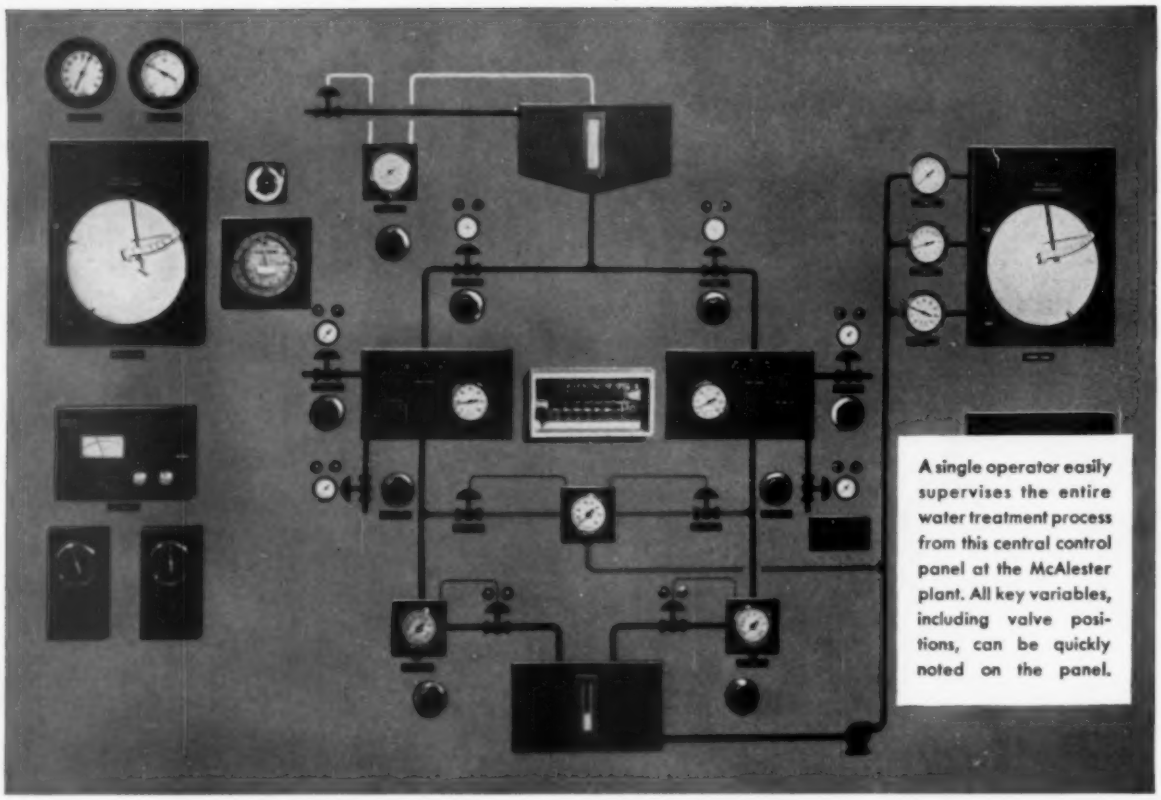


BUILDERS-PROVIDENCE PNEUMATIC MASTER CONTROL SYSTEM and rate-of-flow controllers provide dependable and instantaneous regulation of flows throughout entire system.

CONTROL PANEL in Dallas Pump Station continuously transmits local flows and levels to Wylie . . . from where Synchro-Scan master panel controls Dallas pumps to suit demands . . . further reducing operating costs.



OMEGA BELT GRAVIMETRIC FEEDERS and volumetric liquid feeders for treating water supply were manufactured by another division of B-I-F Industries, Inc.



A single operator easily supervises the entire water treatment process from this central control panel at the McAlester plant. All key variables, including valve positions, can be quickly noted on the panel.

Honeywell *FiltermatiC** system brings
HIGH-RATE, LOW-COST OPERATION
to water plant in McAlester, Oklahoma

With its new Honeywell *FiltermatiC* control system, the recently modernized and expanded water treatment plant at McAlester, Oklahoma, is completely automatic. Control is centralized at the graphic panel shown above, so that one operator can supervise the entire process. The plant supplies 10 mgd to McAlester's 22,000 residents, with treatment rate balanced precisely with demand.

Supply is automatically regulated by three separate but interrelated control loops. One loop controls flow rate from the filters to the clear well, using a cascade system in which level changes at the clear well adjust the set point of each effluent controller. The second loop controls water flow to the filters to maintain a constant level. The third loop controls flow rate from the raw water intake to the clarifier, in accordance with changes in clarifier level.

Treatment chemicals are automatically added in correct amounts through use of a *Differential Converter* which measures raw water flow to the mixing basin, and activates flow accumulators, timers and converters. Dials on the graphic panel indicate any loss of head across each filter, and if head loss exceeds six feet, an alarm sounds. The operator then simply presses a button to start a timer that automatically sequences the entire backwashing cycle.

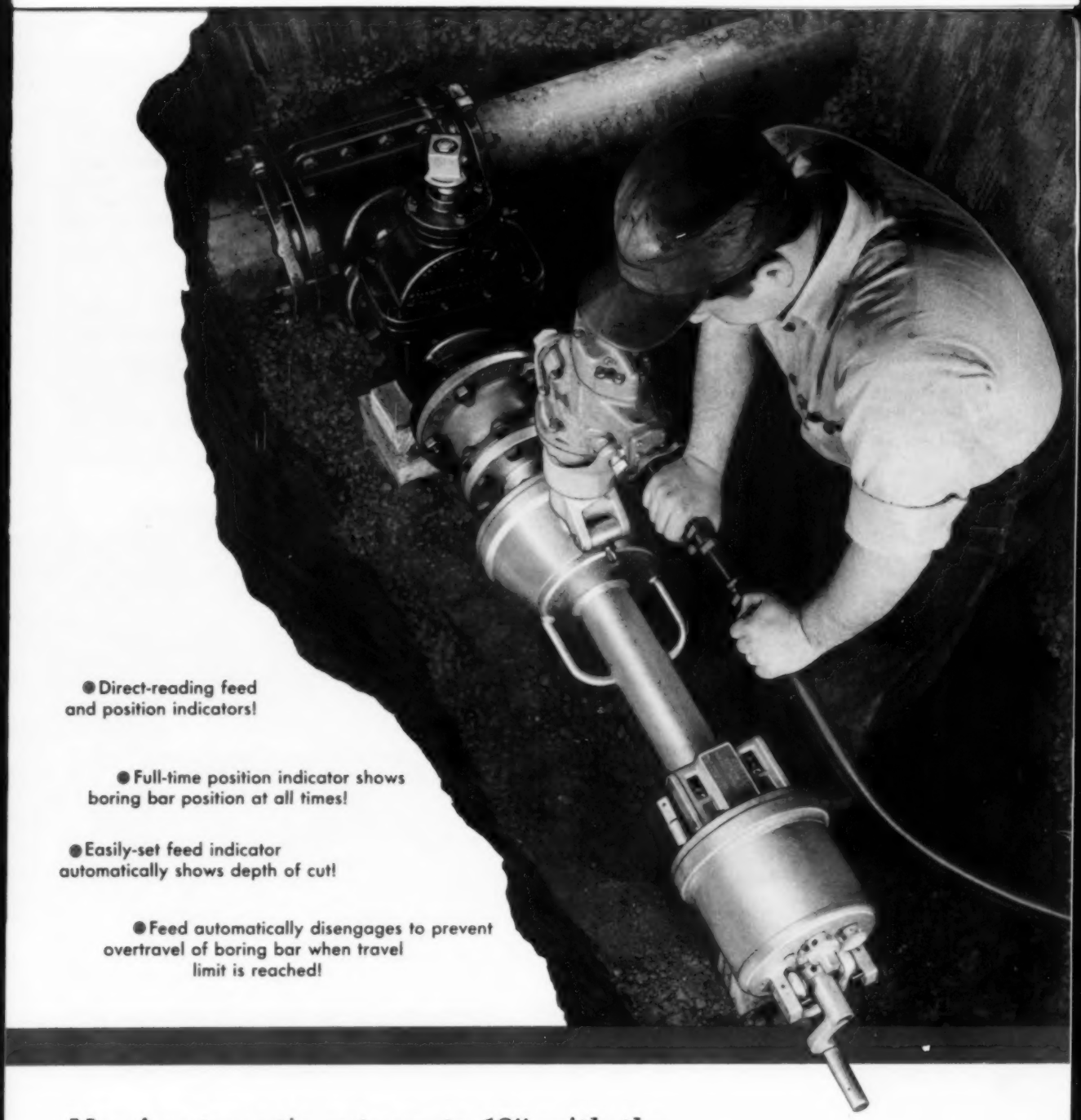
You can gain the many advantages of Honeywell instrumentation in your own plant. Your nearby Honeywell field engineer will be glad to discuss your needs with you and your Consulting Engineer. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Products Group*, Brown Instruments, Wayne and Windrim Avenues, Philadelphia 44, Pa.

**A Tradename of Minneapolis-Honeywell Regulator Co.*

Honeywell

H HONEYWELL First in Controls



- Direct-reading feed and position indicators!
- Full-time position indicator shows boring bar position at all times!
- Easily-set feed indicator automatically shows depth of cut!
- Feed automatically disengages to prevent overtravel of boring bar when travel limit is reached!

Now! automatic cuts up to 12" with the

NEW MUELLER® CL-12

Machine!

New design and new features give automatic operation for faster, safer cuts; more strength for reduced maintenance; simplified operation for use by inexperienced personnel; more compact for easier handling; and standardized tools for simpler tool selection.

MUELLER CO.

DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles; In Canada: Mueller, Limited, Sarnia, Ontario

FORM NO. W-8881

NEW *self-adjusting boring bar packing*

High temperature chevron packing is spring-loaded to insure positive, leakproof sealing without packing adjustments. Line pressure does not enter case.

NEW *rugged all-steel construction*

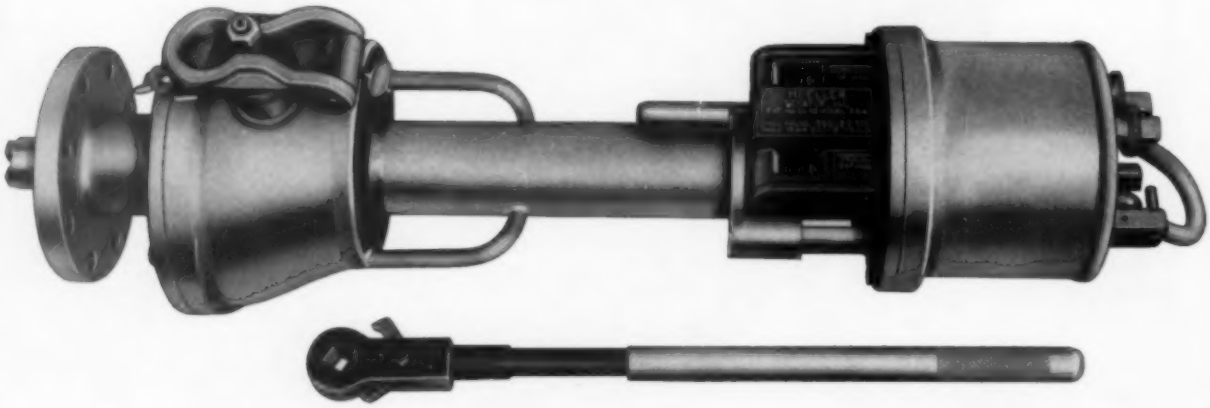
All working parts are totally enclosed in a galvanized steel case to permit complete lubrication and to prevent damage from dirt or other foreign matter and from rough handling. Lubricant is sealed in with "O" rings. Large bearing surfaces assure boring bar rigidity.

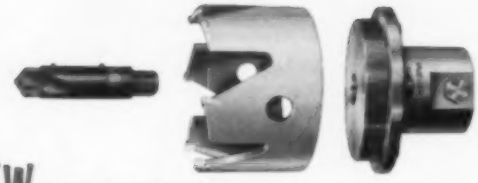
NEW *power or hand operation*

May be hand operated with ratchet handle or power operated with Mueller H-601 Air Motor or Mueller H-602 Gasoline Engine Drive Unit. No changes are required in the machine to use hand or power operation.

NEW *handling ease*

Telescopic design reduces over-all length and weight. Conveniently placed handles and lifting yokes permit easy handling of machine—manually or with hoisting equipment. Front lifting yoke may also be used to lock the boring bar while attaching or removing tools.





NEW *standardized tools*

Tungsten carbide tipped shell cutters are designed for cutting cast iron, cement-lined cast iron, asbestos-cement, reinforced concrete and steel pipe. Tool selection and inventory are greatly reduced. Each shell cutter is specifically designed ½" under the nominal size. This reduces drilling time and travel required and assures perfect cuts. The outside diameter of the cutter is slightly less than the inside diameter of the pipe being cut. Therefore, the cutter makes a complete, clean hole in the side of the main even when making cuts for laterals that are the same size as the main. Cutter hubs for 5½" size shell cutters and larger are of the "E-Z-Release" type. All pilot drills screw into the cutter hub to give greater rigidity and perfect centering. Pilot drill contains a mechanical coupon retaining device. The cutter, hub, pilot drill and coupon can be removed as a unit without first removing coupon.

NEW CL-12 FEATURES

. . . designed to reduce your cutting time!

Now! a new, automatic drilling machine

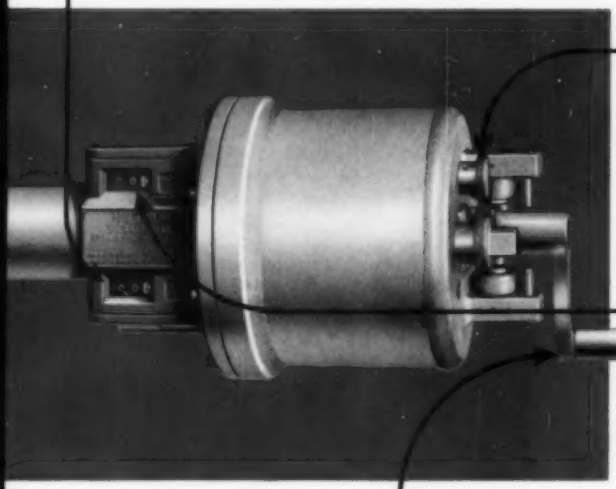
for 2" through 12" cuts in any type of pipe!

NEW *automatic tool position indicator*

Direct-reading indicator shows—at all times—the position of the pilot drill and shell cutter in relation to their fully-retracted or rearmost position. Large numerals read in inches and tenths of an inch and automatically add as the tool is advanced and subtract as the tool is retracted. Eliminates tool position guesswork.

NEW *automatic overtravel protection*

Tool feed is automatically disengaged when the maximum 25" travel of the machine is reached. Damage to the machine is prevented—even when the automatic feed has been set for travel beyond the maximum travel of the machine.



NEW *automatic feed-setting*

The amount of travel required in automatic feed can be quickly and accurately set in inches and tenths of an inch. This amount is clearly shown on the automatic feed travel indicator to insure accurate settings every time.

NEW *automatic feed travel indicator*

As the cut progresses, the direct reading indicator automatically subtracts—always showing the amount of travel remaining in automatic feed. You always know just how much of the cut remains to be made.

NEW *rapid hand travel*

When not cutting, the boring bar may be quickly and easily advanced or retracted by hand. Rapid advancement and retraction of the boring bar reduces time of operation.

NEW *automatic feed disengagement*

When the preset travel in automatic feed is completed and the indicator reads zero, the tool feed is automatically disengaged to prevent damage and loss of time.

Check with your Mueller Representative for complete details.

MUELLER CO. DECATUR, ILL.

specifications

MUELLER CL-12 *drilling machine*

Capacity and Use

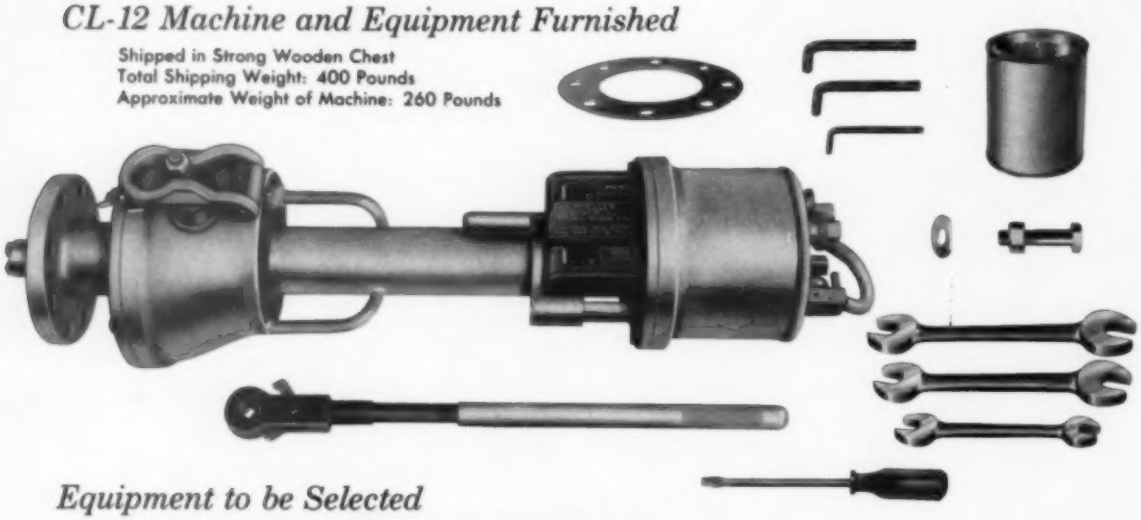
The CL-12 Machine makes cuts from 2" through 12" inclusive in any type of pipe. It is used with tapping sleeves and valves to make lateral connections up to 12" under pressure and to install inserting valves up to 8" in size under pressure.

Working Pressure and Temperature

250 p.s.i. at 100° F.
500° F. at 150 p.s.i.

CL-12 Machine and Equipment Furnished

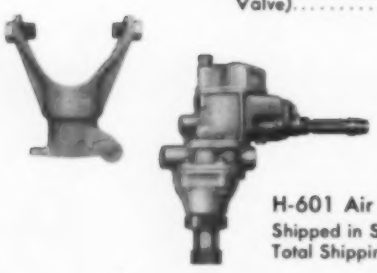
Shipped in Strong Wooden Chest
Total Shipping Weight: 400 Pounds
Approximate Weight of Machine: 260 Pounds



Equipment to be Selected

Power Operating Units, Cutting Equipment (cutter, pilot and hub) and Adapters.

	TAPPING VALVES							
Size of valve ...	2"	2-⅛"	3"	4"	6"	8"	10"	12"
Size of Drill or Shell Cutter	2"	2"	2-½"	3-½"	5-½"	7-½"	9-½"	11-½"
Drill.....	64567	64567	....	....	....	....	....	....
Boring Bar Adapter....	83666	83666	....	....	....	....	....	....
Shell Cutter.....	....	....	83617	83203	83134	83135	83140	83141
Cutter Hub	....	....	83599	83671	83673	83676	83679	83682
Pilot Drill	....	....	83634	83634	83639	83675	83678	83681
Machine Adapter (For Mechanical Joint Tapping Valve)*.....	83668	83669	83367	83368	83369	83370	83371	83372
*Bolts, Nuts ..... and Washers.....	2 ea. 36445	2 ea 36445	Furnished with each Mechanical Joint Tapping Valve 3" size and larger.					
Machine Adapter (For Hub End Tapping Valve).....	83770	....	83361	83362	83363	83364	83365	83366



H-602 Gasoline Engine Drive Unit with Adapter
Shipped in Strong Wooden Box
Total Shipping Weight: 265 Pounds

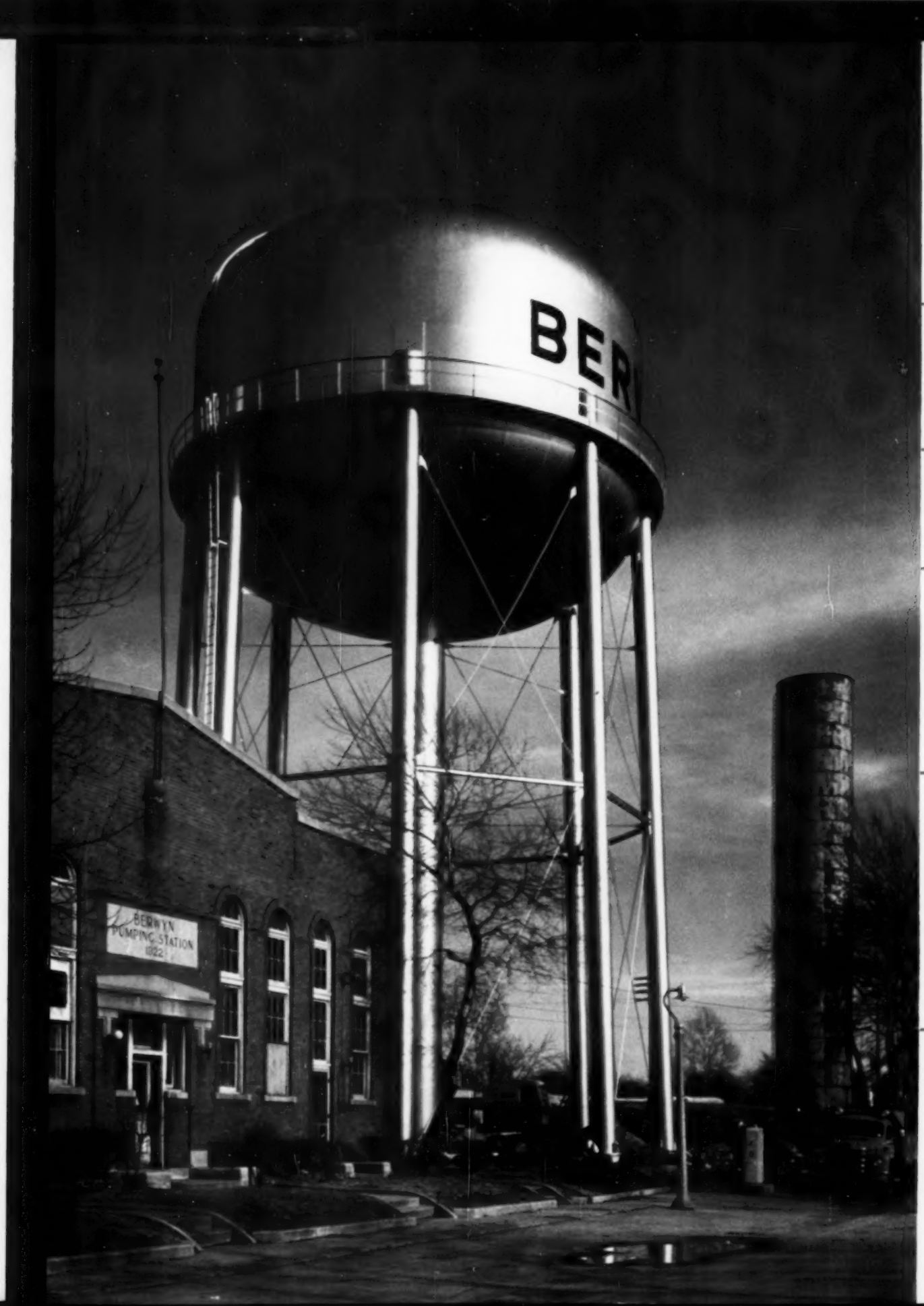
H-601 Air Motor Power Unit with Holder
Shipped in Strong Wooden Box
Total Shipping Weight: 95 Pounds

Order by Quantity and Catalog or Part Number

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles;
In Canada: Mueller, Limited, Sarnia, Ontario

Printed in U.S.A.



FILE REFERENCE

FACT SHEET

GRAVER

New Elevated Tank for Modernized Berwyn, Ill. System

William J. Kriz, Mayor
Anton Pav, Commissioner of Public Works
Frank J. Broucek, Superintendent of Water
Edwin Hancock Engineering Company
Consulting Engineers, Chicago, Ill.
George D. Hardin
General Contractor, Chicago, Ill.
Graver Tank & Mfg. Co., Inc.
Design, Fabrication and Erection

Type: Double Ellipsoidal Elevated Tank
Capacity: 500,000 gallons
Height to Overflow: 100′
Head Range: 35′
Diameter of Tank: 52′
Built to AWWA Specifications
Painted, Sterilized and Cathodic Protected

THE PROBLEM

A thirty-six year old water system supplying the City of Berwyn, Ill., a suburb of 55,000 people near Chicago, was inadequate to maintain uniform water pressure throughout the city during peak demand periods. Chicago water flowed directly into Berwyn mains at 20 lbs. pressure and filled a surface reservoir during low demand. Pumps lifted water into two 150,000 gallon elevated tanks and a standpipe, but these were not high enough to maintain sufficient pressure and were used only for storage. City officials asked for the recommendations of a consulting engineering firm.

THE SOLUTION

A complete revamping of the system was recommended: four new pumps, larger piping at the Water Works and direct pumping from the large surface reservoir were part of the solution. In addition, a new 500,000 gallon elevated water tank, riding on the distribution system, replaced the two low 150,000 gallon tanks and the standpipe. There is now sufficient water in elevated storage to supply the system for about 2 hours during slack periods without pumping.

Graver was selected to design, fabricate and erect the new elevated water tank, as well as to remove the old elevated tanks and the standpipe. Cooperation between the Mayor, Commissioner of Public Works, the consulting engineers, the general contractor and Graver made possible the erection of the elevated tank with minimum inconvenience.

Problems of modernizing or building water supply facilities can be readily solved by talking with experienced consulting engineers and Graver. More than a hundred years of experience in tank fabrication and erection enables Graver to contribute strongly to your plans.

GRAVER TANK & MFG. CO., INC.
EAST CHICAGO, INDIANA

New York • Philadelphia • Edge Moor, Delaware
Pittsburgh • Detroit • Chicago • Tulsa • Sand Springs, Oklahoma • Houston • New Orleans • Los Angeles • San Francisco • Fontana, California

BUILDING FOR THE FUTURE ON A CENTURY OF CRAFTSMANSHIP IN STEELS AND ALLOYS

GRAVER®

DESIGNED, FABRICATED AND ERECTED BY

GRAVER®

GRAVER ELEVATED WATER TANKS

Graver elevated water tanks are expertly fabricated from carbon steel, stainless steel or aluminum at Graver plants across the country and are erected on the site by experienced Graver crews to the highest welding standards.

The selection of one of the standard sizes shown in the table offers the advantage of lowest cost and quick deliveries. Should one of the standard sizes not be suitable, special designs by Graver's engineers is a regular service.

Capacity Gallons	Diameter	Head Range	Number of Columns
25,000	18′-0″	13′-9″	4
30,000	18′-0″	16′-6″	4
40,000	20′-0″	17′-10″	4
50,000	22′-0″	19′-0″	4
60,000	24′-0″	19′-0″	4
75,000	26′-0″	21′-0″	4
100,000	28′-0″	23′-9″	4
125,000	30′-0″	25′-9″	4
150,000	32′-0″	27′-11″	4
200,000	36′-0″	29′-11″	5
250,000	40′-0″	29′-2″	6
300,000	44′-0″	30′-0″	6
400,000	50′-0″	30′-0″	8
500,000	55′-0″	30′-0″	8
750,000	65′-0″	35′-0″	8
1,000,000	86′-0″	25′-0″	12
1,500,000	104′-0″	25′-0″	12
2,000,000	112′-0″	30′-0″	16
2,500,000	122′-0″	30′-0″	16
3,000,000	124′-0″	35′-0″	20

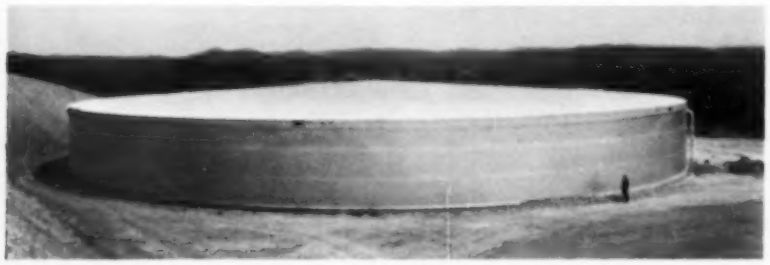
GRAVER PUMP SUCTION TANKS

Graver is an approved fabricator of pump suction tanks under the Factory Mutual Fire Insurance Companies specifications. All standard sizes shown in the table have ¼″ bottoms, 3/16″ self-supporting roofs and shells of thickness such that stress does not exceed 15,000 psi.

Rated Capacity Gallons	Actual Capacity Liquid Depth = Height—6″	Diameter	Height
100,000	100,470	27′0″	23′11½″
150,000	150,120	28′6″	31′11½″
200,000	200,730	33′0″	31′10½″
250,000	250,340	37′0″	31′ 7½″
300,000	300,550	42′0″	29′ 6″

GRAVER STANDPIPES AND RESERVOIRS

Water supply storage tanks whose height exceeds the diameter are referred to as standpipes. When the diameter exceeds the height, they are called reservoirs. Standpipes normally provide static head to the water distribution system; reservoirs usually are intended for storage and reserve supplies. For both types of water tanks, there can be no standard sizes offered. Since the size and form depend upon local conditions and individual requirements, standpipes and reservoirs must be designed in accordance with the special needs of the users and the characteristics of the site.



Building for the Future on 100 Years of Craftsmanship in Steel and Alloys

GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA • NEW YORK • PHILADELPHIA • EDGE MOOR, DELAWARE
PITTSBURGH • DETROIT • CHICAGO • TULSA • SAND SPRINGS, OKLAHOMA
HOUSTON • NEW ORLEANS • LOS ANGELES • SAN FRANCISCO • FONTANA, CALIFORNIA

Equipment News

CONTINUED FROM PAGE 13A

pipe materials on the market today. It is also the lowest price pipe material for average and large diameter piping. Much lighter and easier to ship, handle and install, Plycraft's plywood pipe is easily adapted to any job, as it can quickly be cut to specifications.

The company stated that this new plywood pipe can be used as a replacement or as a direct substitute for all other types of metal, wood or plastic pipes now in use. Under severe tests, it has proved equal to or better than other types of pipe construction in quality, durability, versatility, economy, and ease of handling, installation and fitting.

Speedi-Chuck for Sewer Rod Power Drive

508

Flexible, Inc., Los Angeles, Calif., has developed a new sewer-cleaning timer-saver called the "Speedi-Chuck" for quickly connecting a string of sewer rods to their 2 hp power drives.

Described as "simplicity itself," the device is a spring-loaded snap lock which engages any Flexible rod couplying upon merely pulling back the chuck collar. The groove around the coupling makes the connection.

This new invention is a great convenience to the sewer crew since it is no longer necessary to hold back the coupling with one hand, while inserting a coupling pin through the rod turning shaft with the other. Also there is no coupling pin or spring to get lost or misplaced.

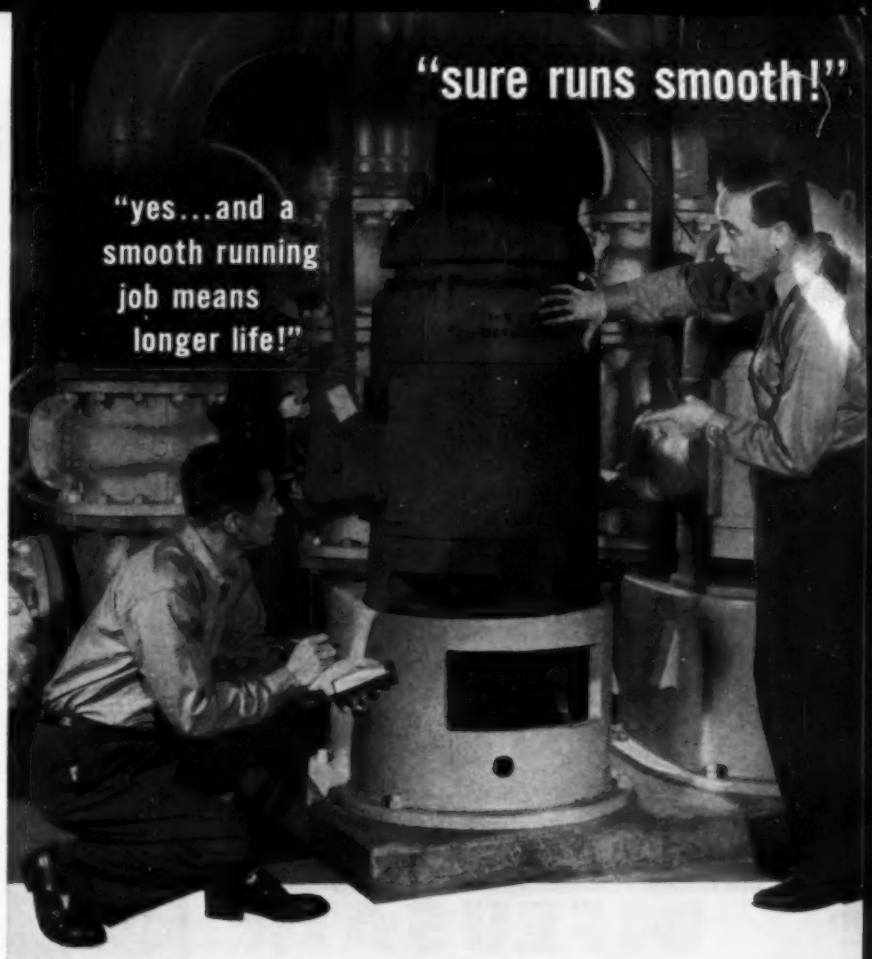
The "Speedi-Chuck" can be installed in minutes on all Flexible 2 hp models in use.

L&N Offers Instrument Repair Service

509

Leeds & Northrup Company, Philadelphia, Pa., has announced that a new 4-echelon Factory Instrument Repair Service is now available through their Field Offices. With this new service the user may specify the type of repair to be made on his equipment.

Repairs are made with utmost speed



In U.S. Verticlosed Motors

progressive balancing eliminates troublesome vibration

One of the first things a new owner notices about the U.S. VERTICLOSED MOTOR is how *smoothly* it runs. And there's good reason for that! Progressive step-by-step balancing the U.S. way reduces vibration to microscopic amplitude. That means *longer pump life* and trouble-free operation.

In U.S. VERTICLOSED MOTORS, not only are all rotating components balanced separately, but the *assembled motor* is balanced! Unlike ordinary pump motors, U.S. VERTICLOSED MOTORS are designed with provision for adding tiny weight increments for final balancing. The assembled motor is vibrometer-tested and corrected to less than .00084" movement before it can pass final inspection. RATINGS 1½ TO 500 H.P. In any pump installation, be sure to specify: "U.S. VERTICLOSED MOTOR."

U.S. ELECTRICAL MOTORS INC.

P. O. BOX 2058, LOS ANGELES 54, CALIF. OR MILFORD, CONN.

FREE COLOR-ILLUSTRATED BROCHURE . . . For full information, send for FREE illustrated Verticlosed Bulletin.

DIFFUSAIR SPARJERS

AN ORIGINAL WALKER PROCESS DEVELOPMENT

Odessa, Texas where six main aeration tanks, two holding tanks and two grease removal tanks are SPARJER equipped. Walker Process also furnished CIRCULAR COLLECTORS, FLOTATION UNIT, DIGESTER MIXER, HEATX SLUDGE HEAT EXCHANGER AND SKIMMERS at Odessa.

Parkhill, Smith & Cooper, Lubbock, Texas • Consulting Engineers
Mr. M. Breneman — Plant Superintendent

Diffusair SPARJERS, designed and developed by Walker Process, represent years of research and experimentation in conjunction with a continuing study of oxygenation processes. As the number of new and tube replacement installations increase, more and more Engineers and Plant Superintendents recognize that SPARJERS successfully combine controlled air bubble release with increased tank turbulence and circulation velocities to achieve an oxygenation efficiency actually superior to other types of diffusion devices.

In developing the SPARJER, Walker Process Engineers thoroughly investigated all factors pertaining to the complex processes involving aeration and oxygenation. As a result Diffusair SPARJERS provide maximum oxygen absorption and include such features as CLOG-PROOF SELF CLEANING ORIFICES . . . NO AIR FILTERS REQUIRED . . . POSITIVELY NO BACK PRESSURE BUILD-UP . . . ECONOMICAL OPERATION.

Full-sized plant tests conducted at SPARJER installations in recent years have demonstrated their superior design. In many cases SPARJERS are installed on existing headers which formerly supported diffusion tubes.

The complete SPARJER story is covered in Walker Process Bulletin Number 22S90. Here the theory and development is discussed in detail along with actual plant experience and data. Write for your copy today.

WALKER PROCESS

WALKER PROCESS EQUIPMENT INC.
FACTORY • ENGINEERING OFFICES • LABORATORIES
AURORA, ILLINOIS

Equipment News

CONTINUED FROM PAGE 17A

by a special Repair Group at L&N's Philadelphia Factory. Emergency service is also available.

Valve and Pressure Tester

510

Farris Engineering Corp., Palisades Park, New Jersey, has developed a new, lightweight instrument for hydrostatic testing of valves and other pressure equipment. Called the "HydroKit," the unit weighs only 17 pounds and can be taken anywhere.

Consisting of a 3,000 psi hand-operated pump, accurate pressure gauge and easy-to-fill reservoir base, the HydroKit is simple to operate, requiring no previous training. The

unit also includes a pressure connection for permanent piping, but is primarily designed for use without an external power source. A 0-500 psi pressure gauge is standard, but other gauges with ranges from 0 to 3,000 psi are available on request. Other accessories include hydraulic flexible tubing and a steel carrying case.

Remote Switch Sump Pump

511

Piqua Machine & Manufacturing Co., Piqua, Ohio, is now producing a new pump in their sump pump line. The new development with the "Enpo" (Engineered Power) submersible sump pump is remote switch operation. A standard switch is mounted on the discharge pipe high above the pump itself and clear of the water area. This new position makes the switch easy to install, easy to adjust to the desired cycle, and easy to service.

TC TENNESSEE CORPORATION

Ferri-Floc
FERRIC SULFATE

The Superior COAGULANT
With The Plus FACTORS—

Ferri-Floc gives smoother, more efficient and trouble free operation. Whatever your particular water treatment problem may be, you can depend on Ferri-Floc doing a superior job and doing it efficiently and economically — Ferri-Floc is a free flowing granular salt which can be fed with few modifications through any standard dry feed equipment. It is only mildly hygroscopic, thereby permitting easy handling as well as storage in closed hoppers over long periods of time.

WATER TREATMENT
Efficient coagulation of surface or well waters. Aids taste and odor control—Effective in lime soda-ash softening. Adaptable to treatment of nearly all industrial waters.

SEWAGE TREATMENT
Ferri-Floc coagulates water and wastes over wide pH ranges—it provides efficient operation regardless of rapid variations of raw sewage and is effective conditioning sludge prior to vacuum filtration or drying on sand beds.

Excellent taste and odor control
Increased filter runs
Coagulation over wide pH ranges
Rapid floc formation
Economy
Turbidity removal
Color removal
Manganese and Silical removal
Bacteria removal
Ease of Operation

Ferri-Floc TC FERRIC SULFATE

SULFUR-DIOXIDE HIGHEST QUALITY SO_2

SULFUR-DIOXIDE is effectively used for dechlorination in water treatment and to remove objectionable odors remaining after purification.

COPPER SULFATE TC

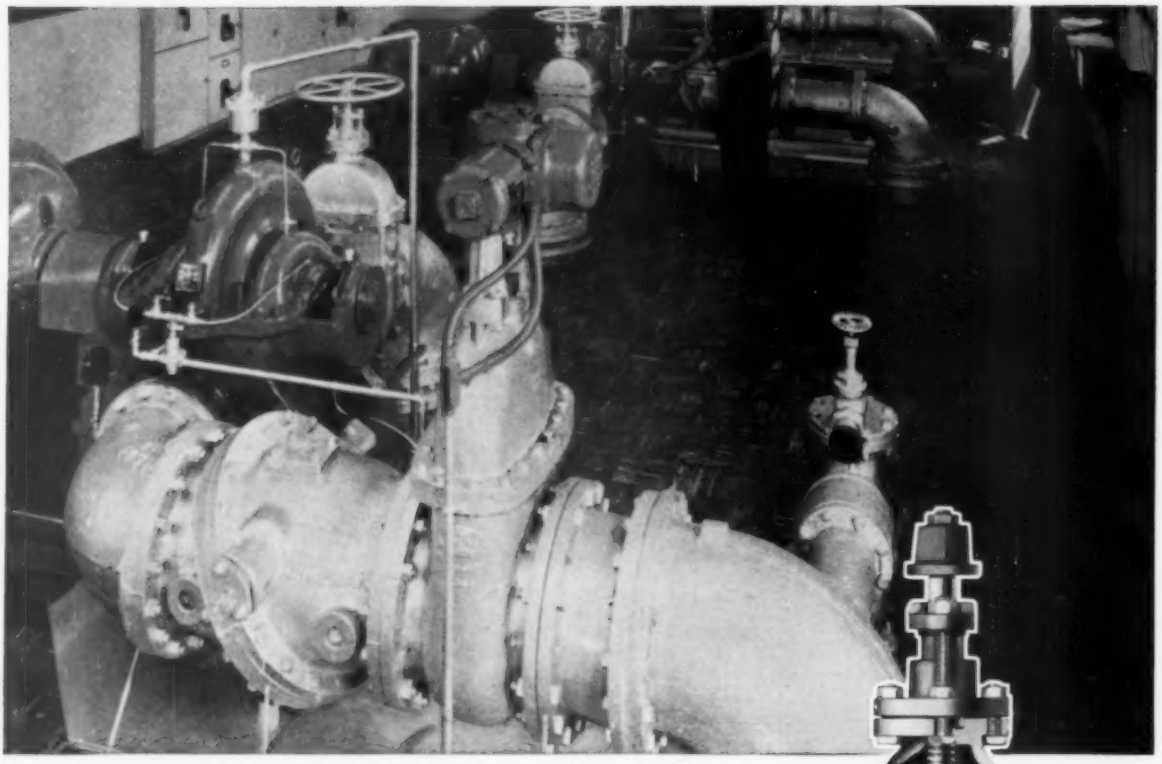
COPPER SULFATE will control about 90% of the microorganisms normally encountered in water treatment plants more economically than any other chemical.

FREE BOOKLET

Let us send you without charge, a 38 page booklet that deals specifically with all phases of coagulation—just send us a postal card.

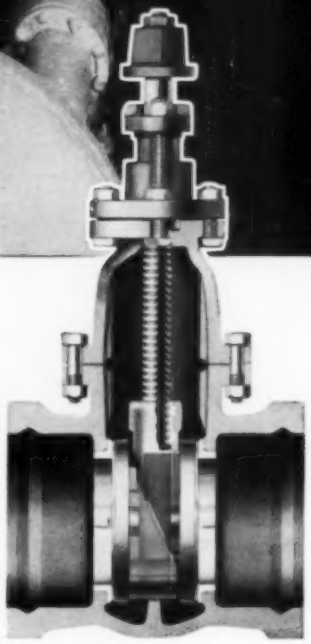
TENNESSEE TC CORPORATION

617-629 Grant Building, Atlanta, Georgia



Sustained top performance

. . . a **DARLING** gate valve bonus!



This cutaway shows the Darling principle that assures uniform wear distribution, automatic seating compensation, prolonged tight closure and unusual valve life.

HERE'S a point to bear in mind about the Darling valves installed in this fine new water pumping station at Tonawanda, N. Y. As in so many other applications everywhere, those Darling gate valves are bound to grow old, in years, but they'll *stay young* in performance!

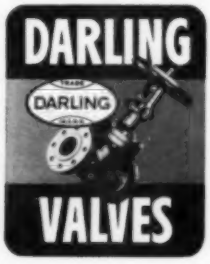
It's the precision manufacture and the Darling fully revolving double disc parallel seat principle that always makes a world of difference! It means prolonged tight closure, avoidance of trouble and low maintenance through the years.

Look into these facts . . . and make Darling gate valves *your* first choice. They are available in types, sizes and with the proper ends for virtually all requirements. Send for Bulletin 5403.

DARLING VALVE & MANUFACTURING CO.

Williamsport 11, Pa.

Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ont.



New Bulletins *AVAILABLE FREE*

Sewage Primer

512

Yeomans Bros. Co., Melrose Park, Ill., is offering a 40-page primer on sewage pumping and treatment to architects and engineers for distribution to builders and others interested in community facilities.

The Little Red Book, titled "The Home Builders Guide to Effective Disposal" covers a comprehensive variety of situations encountered by builders in the collection, disposition and treatment of sewage. The non-technical case history presentation spells out the ABC's of sewage handling for single homes as well as developments up to 1,500 homes.

Sewage Plant Odor Control

513

Rhodia, Inc., New York, N. Y., has just published an attractive 2 color guide for the application of Alamask Odor Control Chemicals which have been specifically designed for use in Municipal Sewage Plants.

According to the guide, these Alamask products offer the most economical form of odor control without the need of installation of costly equipment. Alamask Odor Control Chemicals can in most instances be substituted for prechlorination, with an important savings on the plant budget.

Automation of Chemical Feeders

514

Omega Machine Co., division of B-I-F Industries, Inc., of Providence, R. I., has just published a bulletin presenting a number of methods of automatically controlling the concentration of chemical additives that are in current use in industrial and municipal installations.

This eight-page bulletin contains schematic diagrams of ten typical control and proportional pacing arrangements, ranging from remote-control rate setting to self-checking and self-regulating systems. It tells how automatic feeder control can provide better control of ingredient proportions, free manpower for other duties, prevent waste, contribute to safety, increase production, and make service more reliable.

3-Way Diaphragm Control Valves

515

Minneapolis-Honeywell Regulator Company, Valve Division, Fort Washington, Pa., has just released a new 4-page Specification that gives full details of construction on Honeywell Series 800, 3-way Control Valves. Covered are both single and double-seated designs for mixing or diverting service. Included in the Specification are sizes, materials, pressure ratings and cross-section drawings of body types.

Diesel Engine Selection

516

Detroit Diesel Engine Div., General Motors, Detroit, Mich., has just released a 16-page booklet outlining what diesel engine users should know and look for when selecting engine fuel.

Entitled "Fuel Oil and High-R.P.M. Diesel Engines," the booklet applies to all makes of diesels which operate between 1200 and 3000 R.P.M. and are used in such applications as buses, trucks, earthmoving equipment, pumps, oil rigs, air compressors, boats, generator sets, etc.

The booklet points out the effects of various grades of fuel on diesel engine life and performance. It includes a fuel selection chart to assist engine owners and operators in selecting the type of fuel that will result in the most satisfactory operation of their engines.

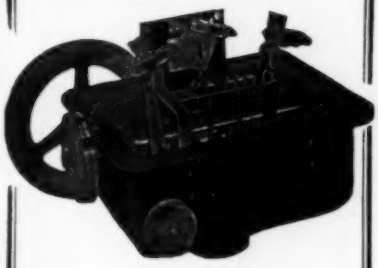
Shafted Mounted Drive

517

Falk Corp., Milwaukee, Wis., has just released a new 32-page illustrated bulletin that describes the complete line of Falk all-steel helical gear, Shaft Mounted Drives for applications in the range from ½ to 50 hp and from 420 to 5 rpm output speed.

The new bulletin includes description of unit design and construction; suggestions on using Shaft Mounted Drives to solve various application problems, plus 2 pages of installation pictures; full information on how to select the proper size and ratio of unit, including the new high-ratio units and the new size #315 for higher hp; sheave and belt selections; and data on accessories.

ROTO-TROL



RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles.

The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

Write for full data

WATER LEVEL CONTROLS DIVISION

HEALY-RUFF COMPANY

783 Hampden Ave., St. Paul 4, Minn.

HYDRO-TITE

DEPENDABLE JOINTING COMPOUND

Seals Bell and Spigot Water Mains

Economical—Effective

Over 35 Years Of Dependable Performance

HYDRAULIC DEVELOPMENT CORP.

MAIN SALES OFFICE 50 CHURCH ST., N. Y. C.

General offices and works W. Medford Sta., Boston, Mass.

The Houston Water Purification Plant was one of the first plants to use rubber-seated butterfly valves in filter service. Freese, Nichols and Turner, Consulting Engineers, chose R-S Rubber-Seated Butterfly Valves over conventional gate valves for all low-pressure service because their compact design permitted close coupling of pipe. Result: a substantial saving in space, and a direct, in-place cash saving of $124,000.

Houston, Texas, Reports: COMPLETELY SATISFIED WITH R-S BUTTERFLY VALVE OPERATION

When the Houston Purification Plant went into operation in 1954, 65 R-S Rubber-Seated Butterfly Valves were used to equip the entire low pressure system. Today, Mr. Harvill reports that these valves are giving good service, and that he is fully satisfied with their performance and minimum maintenance requirements during their first years of operation.

R-S Rubber-Seated Butterfly Valves are easy to operate, and will provide 100% effective shut-off with a 125-pound pressure drop. Wedging action of the vane against the tough, flexible rubber seat assures positive closure, even around shaft bosses. The special composition of rubber and other materials gives long wear and resistance to the abrasive action of material flow.

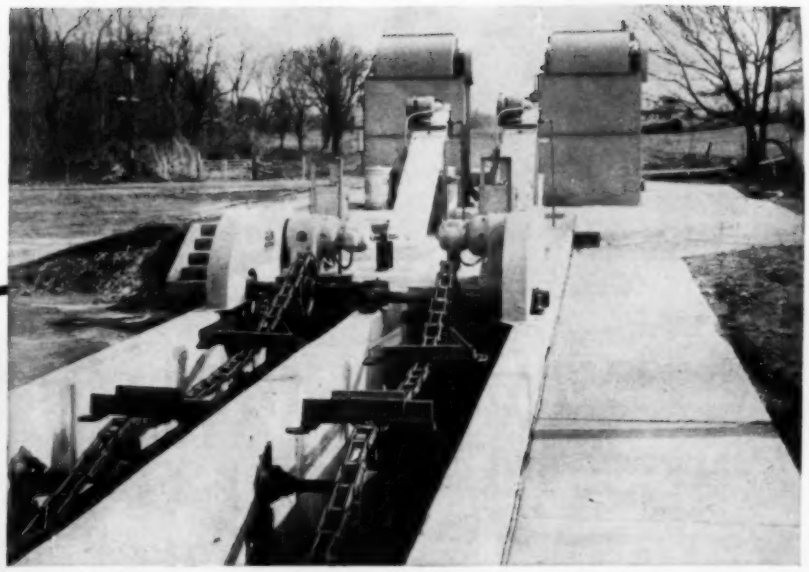
To obtain complete information on the full SMS line – Butterfly Valves, Rotovalves and Ball Valves – see our local representative, or write S. Morgan Smith Company, York, Penna.

S. MORGAN SMITH HYDRODYNAMICS

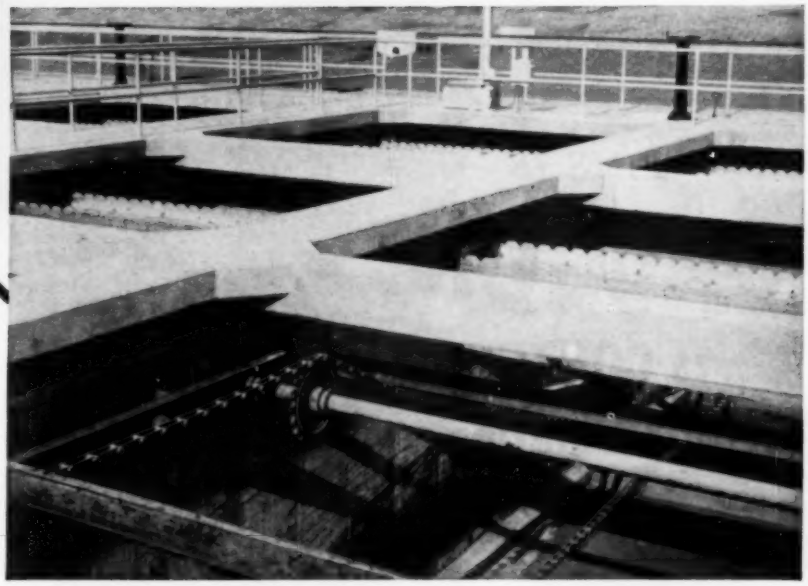
AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

1

Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories



INFLUENT enters parallel channels. Thru-Clean bar screen (background), mounted in each channel, removes trash and debris. Link-Belt roller chain drives each screen through a gearmotor. Inorganic matter such as grit, sand and gravel is removed from the sewage as it passes through the grit chambers (foreground). Each grit collector consists of a strand of 6-in. pitch combination chain with 3/8-in. steel angle flights attached every 5 ft.



EFFLUENT end of settling compartment of pre-aeration settling tanks shows Link-Belt Promal chain and redwood flights used on Link-Belt Straightline longitudinal sludge collectors. Flights, mounted every 10 feet, travel at 2 feet per minute. Flights collect sludge from both settling and pre-aeration compartments. The combination of pre-aeration and settling results in a removal of 70-80 per cent of suspended solids. Weirs at far end of compartment discharge effluent to outfall sewer to river.

How Link-Belt equipment is helping Henderson, Kentucky,

halt river pollution

COOPERATING with the Ohio River Valley Water Sanitation Commission, Henderson, Ky., has recently completed an efficient treatment plant to eliminate dumping of raw sewage into the Ohio River. Consulting engineers were J. Stephen Watkins and Robert E. Martin of Lexington and Louisville.

As in so many other municipalities, Link-Belt equipment was specified for an important share of the work. Units include Thru-Clean mechanically cleaned bar screens . . . Straightline grit collectors . . . grit washing and dewatering screens . . . Straightline longitudinal and cross sludge collectors.

This equipment is part of the broad Link-Belt line. Our sanitary engineers will work with your consultants and chemists—help you get the best in water, sewage or waste treatment.

LINK-BELT

SANITARY ENGINEERING EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World. 14,711

This is **tuberculation**

. . . it cuts down flow capacities
. . . it raises pumping costs

This is
CALGON®
. . . *it* CONTROLS tuberculation

Water treatment with Calgon brand sodium hexametaphosphate is the simple, economical way to control the corrosion that is so costly to municipal water systems. Reduced capacity and the consequent increase in pumping power are far more costly than Calgon treatment. And Calgon solves other water problems, too.

Calgon treatment is particularly effective after mechanical main cleaning, because its fast film forming ability quickly interposes a barrier between the freshly scoured metal and the corrosive effects of the water.

A report of a 24 month study on the efficiency of Calgon in maintaining pipeline flows is available. Write for a reprint of this paper. A letter or phone call will bring you more information on how Calgon can help. An experienced Calgon engineer will be glad to make detailed recommendations on your specific problem.

Fully licensed under U.S. Patent 2337856.

CALGON COMPANY

DIVISION OF **HAGAN** CHEMICALS & CONTROLS, INC.
HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED, TORONTO

COSTS LESS TO BUY

A single, molded rubber gasket is the only accessory required. There are no bolts, no nuts, no followers, no couplings, no extras.

COSTS LESS TO INSTALL

Assembly is easy and rapid. Rate of installation usually is limited only by the speed of excavating the trench.

JOINT IS TIGHT

Bell-Tite forms a pressure-tight joint instantly. Restrained joint bursting tests prove joint stronger than the pipe itself.

This is it...
CLOW Bell-Tite® Joint Cast Iron Pipe

ALL-WEATHER JOINT

You keep your schedules with Bell-Tite Joint cast iron pipe. It can be easily laid in a wet trench or even under water.

UNDERWRITERS' LISTED

All diameters through 24" listed and inspected by Underwriters' Laboratories, Inc. for working pressures to 350 psi.

AMPLE DEFLECTION

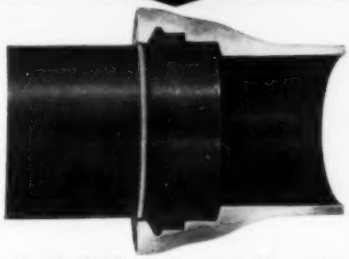
Bell-Tite Joint cast iron pipe is so designed that it will easily accommodate casual curves and normal grades.

MEETS ALL REQUIREMENTS

CLOW Bell-Tite Joint pipe is strong, tough, uniform and durable cast iron pipe for long-life underground service.

ANY SIZE OR THICKNESS

Available in any specified thickness or weight class in accordance with ASA, AWWA or Federal specifications. 3" to 24".



CLOW Bell-Tite Joint is easily assembled—Just wipe clean, lubricate and push spigot into the bell. When painted yellow stripe is no longer visible, joint is bottle tight.

ENTHUSIASTIC RECEPTION

Contractors and Municipalities—men who know pipe—have installed well over 1,000,000 feet of CLOW Bell-Tite pipe.

JAMES B. CLOW & SONS, Inc.

CLOW 1878

201-299 North Talman Avenue, Chicago 80, Illinois

Subsidiaries:
Eddy Valve Company, Waterford, New York
Iowa Valve Company, Oskaloosa, Iowa

6,600 reasons why Greensburg depends on Bailey!

Every day the 6,600 residents of Greensburg, Indiana, use up to 1,000,000 gallons of water. Three Bailey Filter Operating Consoles control and indicate the flow of this water through the rapid sand filters. Space for a fourth console has been provided for future expansion.

Engineers: Moore & Heger

With population growth and industrial expansion comes the opportunity to adopt newer, more economical and more scientific methods of water handling.

Many cities, like Greensburg, are installing Bailey Instrument and Control Systems. Because Bailey can furnish *complete* control systems... made up of *standardized* components... that not only do a better job, but can easily be *expanded* to meet future needs.

Engineers, water superintendents and city officials themselves will tell you that Bailey electric and pneumatic telemetering and control systems are outstandingly reliable and economical, attractive, and easy to maintain.

Ask your qualified Bailey Engineer for recommendations.

W-5

WATER & WASTE TREATMENT DIVISION

BAILEY METER COMPANY

1071 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

SIMPLEX TYPE S RATE OF FLOW CONTROLLER
Direct venturi-actuated. Self-contained . . . operates when all power sources fail.

OVER 5,000 UNITS IN SERVICE PROVE SIMPLEX FILTER CONTROLLERS YOUR BEST VALUE!

Simplex economy and accuracy demonstrated by 25 years' dependability

Simplest way to make sure you're specifying the best: check some installations. Investigate all types and makes of filter controllers. Find out which give the best control . . . which the best balance of initial vs. operating and maintenance costs.

Include the *hidden extras* in total installed cost: space-wasting straight pipe runs before or after the unit; expensive electric or pneumatic positioners with additional circuits. You'll find that venturi-actuated Simplex controllers cut costs because they're completely self-contained . . . require no extras.

Dig into maintenance costs. You'll find direct-acting Simplex controllers give long years of trouble-free service. They're self-operating . . . need no positioners, have fewer moving parts, virtually friction-free action.

Take a second look at performance. With Simplex you'll find low head loss that saves on pumping. And straight-line accuracy to the end point that makes for longer filter runs.

Simplex can help you save money on your next expansion or your new plant. Ask us to prove it!

MAIL THIS COUPON TODAY!

SIMPLEX®
VALVE AND METER COMPANY
a subsidiary of PFAUDLER PERMUTIT INC
Venturi Tubes • Flumes • Meters • Gauges
Transmitters • Controllers • Tables • Air Valves

SIMPLEX VALVE & METER CO., Dept WS-5,7 East Orange St., Lancaster, Pa.

Send me new Technical Bulletin 900 that gives valuable design and performance data on Filter Controllers and Master Control Systems.

NAME_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

OLIVER

SUPER 88 HYDRO-TRENCHER

"We bought the Oliver after watching it perform for others"

"And there was only satisfaction in what we saw," says this owner of a Hydro-Trencher in Yonkers, N.Y.

And here's what some other owners have told us:

★ "The Hydro-Trencher does 25% more work than any comparable rig we have ever seen."

★ "It would take three men 6 or 8 hours to do what our Hydro-Trencher does in 30 minutes."

★ "Our Oliver has performed so well that 3 others in our area have bought Super 88 Hydro-Trenchers."

★ "In light or heavy work it can't be beat."

★ "After 2 years, maintenance has been negligible."

After all, when you're buying a back hoe, you're buying *performance*...the ability to dig faster, easier, at lower cost. So why not see for yourself?

Your Oliver distributor will gladly refer you to some owners of the Super 88 Hydro-Trencher in your area. Or ask for a demonstration. Let us prove that the Hydro-Trencher can outwork them all.

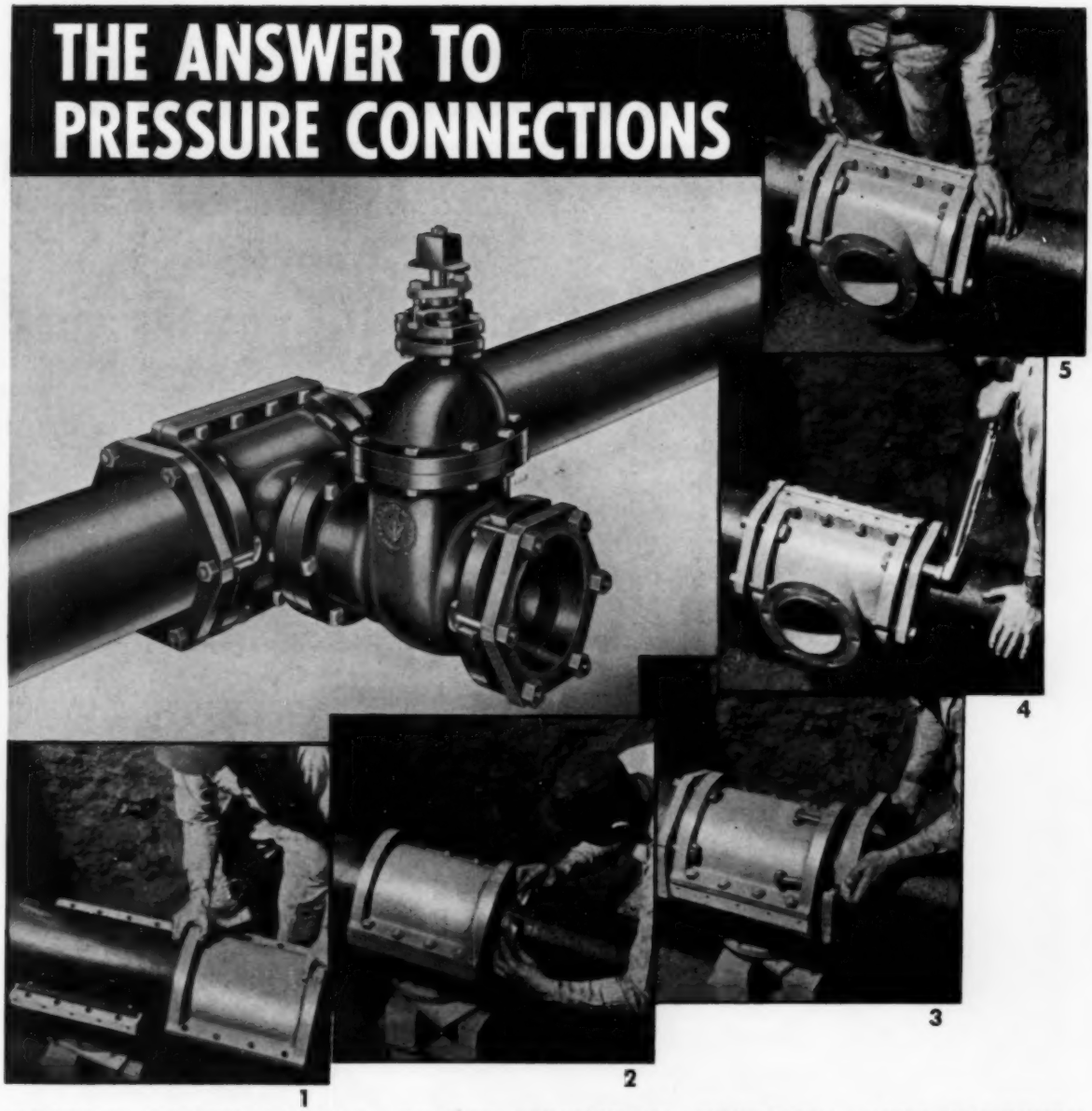
Oliver Super 88 Hydro-Trencher—a versatile rig for trenching and excavating; ½-yd. hoe bucket digs to 12′ depth, loads to 12′ height. Digs through hardest soils, even frozen ground. Highly mobile with six travel speeds from 2 to 16 m.p.h. Gasoline or diesel engine.

OLIVER

THE OLIVER CORPORATION

Industrial Division, 19300 Euclid Ave., Cleveland 17, Ohio

THE ANSWER TO PRESSURE CONNECTIONS



SMITH MECHANICAL JOINT TAPPING SLEEVES AND VALVES

Installing Smith Mechanical Joint Tapping Sleeves and Valves is the up-to-date way to make connections, sizes 2″ and larger under pressure. Installation can be speedily completed in any weather, even in wet excavations. The only tools required are two wrenches. Here's how: (1) Clean pipe — position and bolt sleeve halves on pipe. (2) Position and press gaskets into sleeve ends until evenly seated. (3) Attach split follower rings and hand tighten bolts and nuts. (4) Locate sleeve with outlet flange in desired position — tighten follower ring bolts and nuts. (5) Tighten side flange gasket compression screws — attach tapping valve. The installation is complete and ready for tapping.

56

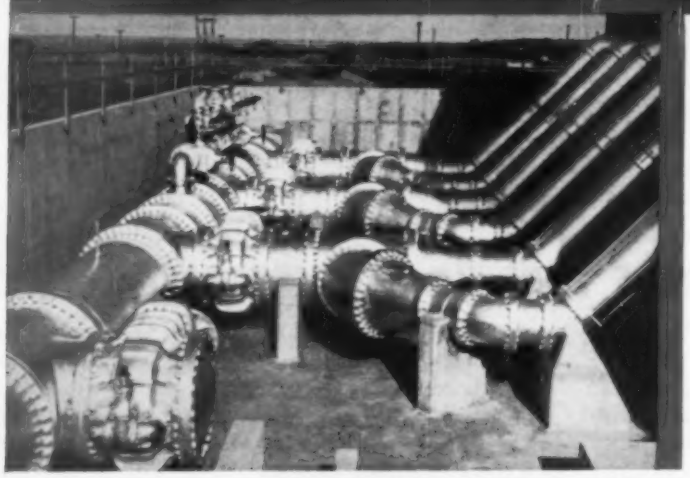
FIRE HYDRANTS · VALVES · SINCE 1896

THE A.P. SMITH MFG. CO.

EAST ORANGE, NEW JERSEY

STRENGTH PLUS

Chicago, Ill.—Cast Iron Pipe for installation of new water main under West Madison Street.



Corpus Christi, Texas—Cast Iron Pipe installation in filtration plant showing 48" discharge manifold which is connected to 48" Cast Iron city supply line.

THE MAN WHO CHOOSES
CAST IRON PIPE TODAY
WON'T PAY FOR IT AGAIN
TOMORROW!

CAST IRON

Cast Iron Pipe Research Association
Thos. F. Wolfe, Managing Director
Suite 3440, Prudential Plaza, Chicago 1, Ill.

MODERNIZED **cast iron**

HIGH FLOW

You get BOTH with CAST IRON PIPE

*Here's the proof of flow

FLOW FACTORS FOR CEMENT LINED CAST IRON PIPE

LOCATION	SIZE	TEST SECT. IN FEET	VELOCITY F.P.S.	AGE YEARS	W & H "C" FACTOR
Bowling Green, Ohio	20"	45,592	0.7-2.4	New	142.5
Chicago, Illinois	36"	7,200	2.6-3.6	New	147
New Orleans, La.	12"	39,650	1.2-2.9	New	141
Corder, Mo.	8"	21,350	0.9-2.3	New	143
Univ. of Illinois	8"	400	3.14	New	150
Concord, New Hamp.	14"	500	1.7-2.2	New	151
Concord, New Hamp.	12"	500	2.0-3.4	11	142
West Palm Beach, Fla.	12"	500	3.6-5.4	15	139.5
Greenville, S. C.	30"	87,376	2.4-2.7	12	148.5
Corpus Christi, Tex.	30"	65,641	1.1-1.8	6	146
Summerville, S. C.	8"	500	1.98-2.43	13	142.5
Champaign, Illinois	16"	3,920	3.1-5.6	22	139.3

*Available upon request: Booklet containing flow test and tables on Cast Iron Pipe.

Here's the proof of strength

1. CRUSHING STRENGTH* . . . Standard 6" Class 150 cast iron pipe will withstand a crushing load, under standard tests, of 17,900 pounds per foot . . . important where heavy fill or shock from heavy traffic loads are encountered.
2. BEAM STRENGTH* . . . Settlement soil movement, or disturbance of the soil by underground construction places a heavy strain on pipe. A length of 6" class 150 cast iron pipe bears up under a load of 20,790 pounds and deflects over 2¼ inches.
3. BURSTING STRENGTH* . . . Tests prove that standard 6" class 150 cast iron pipe withstands internal pressure of 3000 pounds per square inch . . . providing a safety factor ample to resist high working pressures and water hammer.
4. JOINT STRENGTH . . . A full range of leak-proof, low cost, easy-to-assemble joints for pipe and fittings are available to meet all conditions.
5. CORROSION RESISTANCE . . . Cast Iron Pipe resists corrosion . . . vital factor in its proven long life and dependability.

*Based on independent laboratory tests.

pipe FOR MODERN WATER WORKS

PROVO, UTAH, Sewage Treatment Plant

uses two 40' SEDIFLOTOR® Clarifiers instead of two 135' primary sedimentation basins because, for comparable results, they require

...90% less space!...85% lower investment!

Outstanding performance is achieved by *flotation* plus *settling of heavy solids.*

At a flow of 3-4000 gpm per unit, average suspended sludge reduction of 38% is obtained! At 7-8000 gpm, the average reduction is 19%.

In one 12-foot "SEDIFLOTOR" thickener having an average detention time of only 17 minutes, the float and settled solids from the two primary "SEDIFLOTOR" clarifiers, together with the trickling filter humus, are concentrated 40 times!

Date	Influent	Sludge to Digester
12/4/56	1.1820 gm./1	50 gm./1
12/14/56	1.5 gm./1	56 gm./1

Evaluate this new method of primary treatment and sludge thickening. Contact us or one of our field offices for Bulletin 6051.

Inquiries are invited on all problems in the treatment of waters, sewage and wastes for municipalities, institutions and general industry.

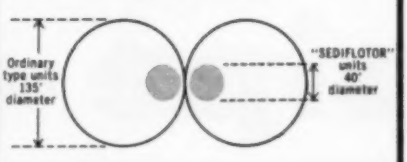
SEE YOUR CONSULTING ENGINEER... If you are planning installation of any major equipment, the services of a reliable Consulting Engineer can be invaluable.

Templeton and Linke
Consulting Engineers
Salt Lake City, Utah

Photo shows the two 40'
"SEDIFLOTOR" primary clarifiers

57424

How "SEDIFLOTOR" units save space at Provo



INFILCO
INCORPORATED
General Offices • Tucson, Arizona • P.O. Box 5033
Field offices throughout the United States and in foreign countries

INFILCO

THE ONLY COMPANY impartially offering equipment for ALL types of water and waste processing—coagulation, precipitation, sedimentation, filtration, ion exchange, flotation and biological treatment.

For Important Information
on Products and Services
see the 1957-1958
WATER & SEWAGE WORKS
REFERENCE and DATA NUMBER

The following firms have information of interest to you in the 1957-58 REFERENCE and DATA NUMBER

Airkem, Inc.
Alabama Pipe Co.
Allis-Chalmers
Amercoat Corp.
American Vitrified Prod. Co.
American Well Works
Anthracite Equipment Co.

Bailey Meter Co.
Beaumont Birch Co.
Bethlehem Steel Co.
B-I-F Industries, Inc.
Borden Metal Products Co.
Builders-Providence Inc.
Byron Jackson Pumps, Inc.

Chain Belt Co.
Chicago Bridge & Iron Co.
Chicago Pump Co.
Clarksville Foundry & Machine Works
Jas. B. Clow & Sons (Iowa)
R. D. Cole Mfg. Co.
Columbia Southern Chem. Co.
Combustion Engineering, Inc.
Cook Well Strainer Co.

Dorr-Oliver, Inc.

Fischer & Porter Co.
Foster Enineering Co.

General Chem. Div.
Allied Chem. & Dye Corp.
General Filter Co.
Golden-Anderson Specialty Valve Co.
Graver Tank & Mfg. Co.
Graver Water Conditioning Co., Inc.

Hardinge Co., Inc.

Infilco, Inc.
Ingalls Iron Works Co.
International Minerals & Chemical Corp.
Iowa Valve Co.

Jeffrey Mfg. Co.
Johns-Manville
John Wiley Jones Co.

Komline-Sanderson Engineering Corp.

Link-Belt Co.
Ludlow-Rensselaer Valve Mfg. Co.

M & H Valve & Fittings Co.
Millipore Filter Corp.
Morse Boulger Destructor Co.
Multiplex Mfg. Co.

Natco Corp.
National Clay Pipe Mfrs., Inc.
National Power Rodding Corp.
Neptune Meter Co.
Nichols Engineering & Research Corp.

Olin-Mathieson Chemical Co.
Omega Machine Co.

Pacific Flush Tank Co.
Pennsalt Chemical Corp. (Western Div.)
Permutit Co.
Phipps & Bird, Inc.
Henry Pratt Co.
Presstite-Keystone Engineering Products Co.
Pressure Concrete Co.
Proportioneers, Inc.

Rensselaer Valve Co.
Roberts Filter Mfg. Co.

Schramm, Inc.
Simplex Valve & Meter Co.
Smith & Loveless, Inc.
S. Morgan Smith Co.
A. P. Smith Mfg. Co., Inc.

Tennessee Corp.

U. S. Pipe & Foundry Co.

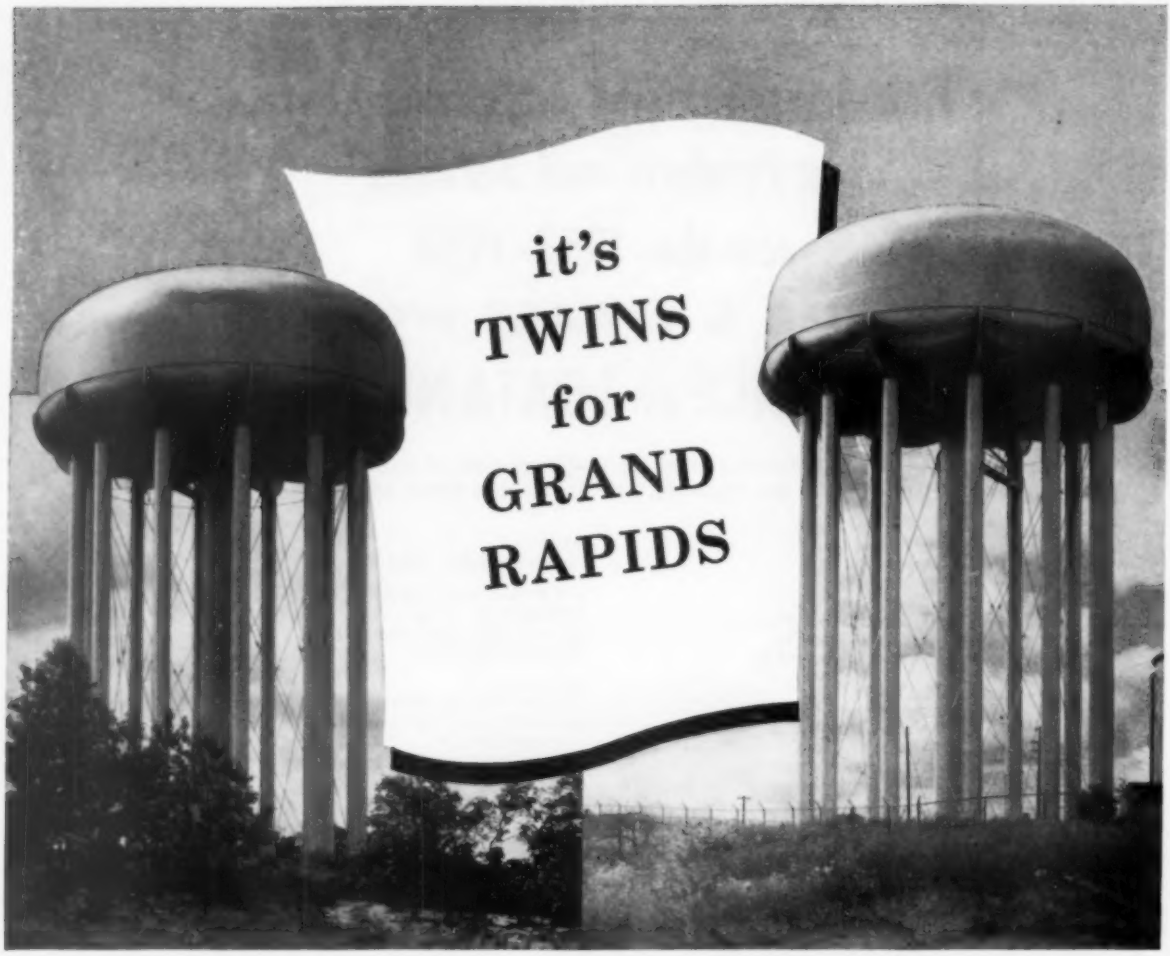
Walker Process Equipment, Inc.
Wallace & Tiernan, Inc.
Washington Aluminum Co.
Water Seals, Inc.
Western Machinery Co.
White Diesel Engine Div.
Worthington Corp.

Yeomans Bros. Co.

SCRANTON PUBLISHING COMPANY, INC.
185 N. WABASH AVE., CHICAGO 1, ILL.
155 E. 44th ST., NEW YORK 17, N. Y.

SCRANTON GILLETTE PUBLICATIONS

WATER & SEWAGE WORKS • INDUSTRIAL WASTES
REFERENCE and DATA NUMBER • MODERN HIGHWAYS



Two 1,250,000-gal. Horton Radial-Cone Tanks provide modern water storage

It's identical twins for the city fathers of growing Grand Rapids, Michigan!

These two Horton® radial-cone bottom elevated tanks provide 2,500,000 gallons additional water storage capacity and provide dependable gravity pressure to meet peak load periods in suburban Grand Rapids. The two tanks stand 95 feet to the bottom and have a 30 ft. range in head.

By reducing the load on a community's over-worked pumping, treating and transmission facilities, Horton elevated tanks improve distribution pressures, provide emergency reserves, improve insurance ratings and reduce pumping costs.

Horton radial-cone bottom tanks are built in capacities to 3,000,000 gallons. Combining sound engineering with practical design they can take the "pain" out of *growing* for your community. Write our nearest office for further information.

Two identical 1,250,000-gallon Horton radial-cone bottom elevated tanks built for Grand Rapids, Michigan.

CBI

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • South Pasadena • Tulsa
Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PA.

Our representative can explain to you how simplicity of design minimizes maintenance—and to see the R. D. Wood Hydrant you needn't leave your office chair.

"Don't Get Up! Sit Right Where You Are and Let Me Show You the R. D. Wood Hydrant"

"With this scale model I can show you why the R. D. Wood Hydrant has earned its reputation for reliability, strength and permanence. It is simple in construction, too—a fact that makes it low in cost and easy to repair in case of accident.

"The full area main valve is cone shaped to prevent water hammer. It opens *against* water pressure, so that if it is broken in a traffic accident, water pressure will hold it closed. This prevents loss of water, lowering of water pressure, and flooding."

Would you like to see it? Our representative will bring in a scale model and show you its advantages right in your office. Drop us a line today and he will telephone you for an appointment at your convenience.

R. D. WOOD COMPANY

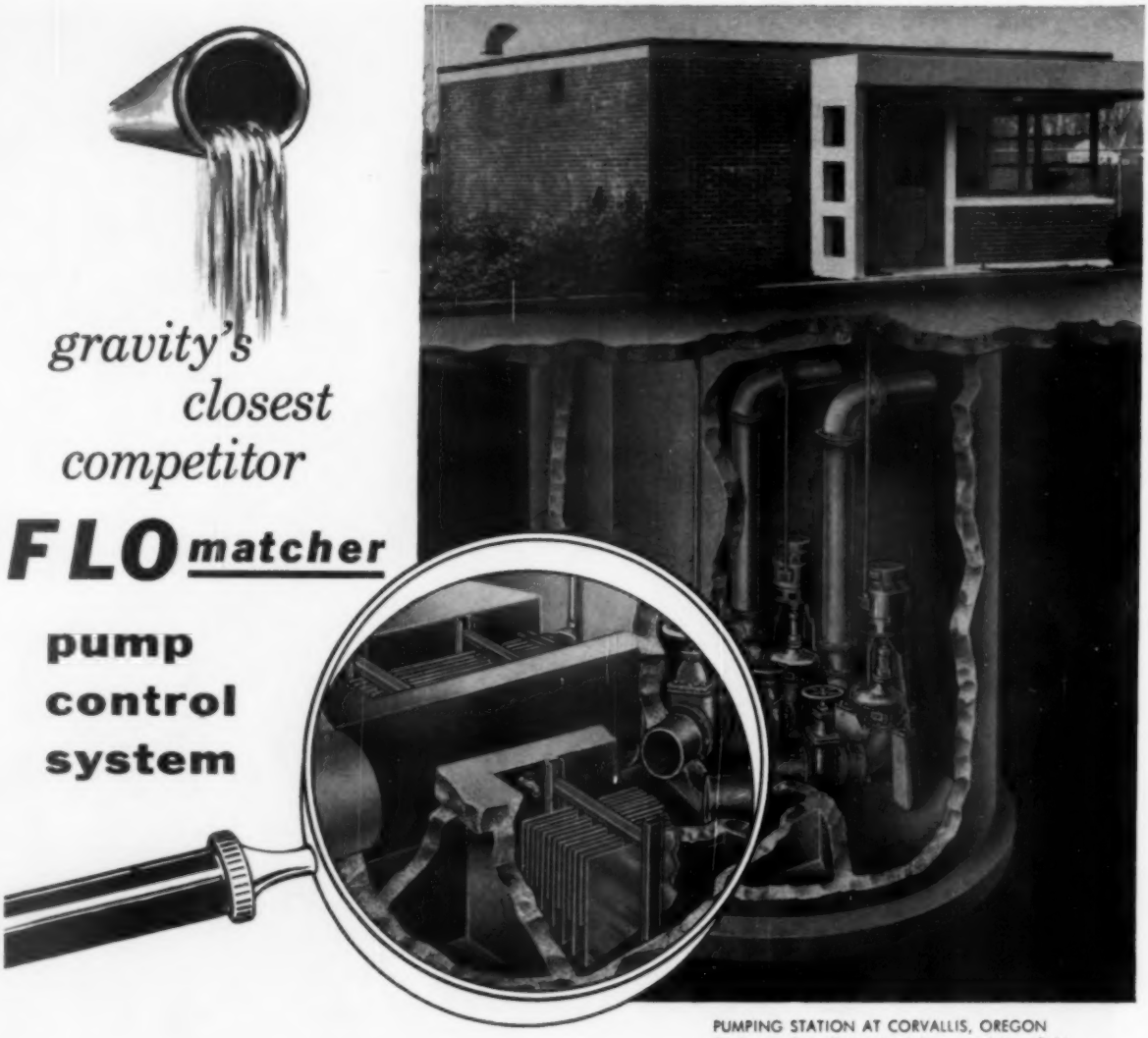
Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)

gravity's closest competitor

FLOmatcher

pump control system



PUMPING STATION AT CORVALLIS, OREGON
Engineers: Cornell, Howland, Hayes and Merryfield
Station Energized: May, 1954

Gravity is the best, most reliable force for transporting sewage. But gravity can't move sewage uphill—FLOmatcher *can* and *does*. Based on a liquid rheostat (see enlarged cutaway) and wound rotor (slipring) motor, the FLOmatcher system, with no moving control parts, no electronics, no floats, lifts sewage uphill with the same dependable, surge-free precision that is found in gravity-powered, downhill flows.

FLOmatcher is ideal for nearly every sanitary and storm drainage pumping plant. FLOmatcher eliminates pumping rate steps and surges and cuts maintenance to almost nothing. Its long life, low operating costs, and construction economy can benefit you on your next pumping station job.

Proved in more than 25 installations during 6 years of trouble-free operation before it was offered commercially, FLOmatcher is worth investigation.

only gravity is as reliable and economical as FLOmatcher

a product of
GENERAL SERVICES CO.
CORVALLIS, OREGON

For full details on the FLOmatcher Pump Control System, use Reader Service Card or contact:

GEORGE M. OSGOOD CO.
NATIONAL SALES REPRESENTATIVE
P. O. BOX 361, PORTLAND, OREGON · CA 2-1953

OVER A HUNDRED YEARS OLD...

"...in good working order"

CITY OF ALBANY, N. Y.

DEPARTMENT OF WATER AND WATER SUPPLY

WILLIAM F. DEVANE
COMMISSIONER

JOSEPH M. LAPENIS
DEPUTY COMMISSIONER

THOMAS F. FITZSIMMONS
SUPERINTENDENT
METERS AND ASSESSMENTS

JOHN C. MCDONALD
CASHIER

October 25, 1957

Eddy Valve Company
Waterford, New York

Gentlemen:

We are enclosing a picture of a 8" Eddy Valve placed in service some time previous to the year 1851, this being the year the City acquired the Water Supply from a private company.

How many years prior to 1851 this valve was installed is problematical as Cast Iron water mains have been used in this city since the year 1813.

This valve is in the distribution system and is in good working order. In checking over a report of George W. Carpenter, Superintendent of the City Water Works, dated January 16, 1854, we find that valves at that time were called stop cocks.

We thought perhaps you would be interested in knowing about your product.

Very truly yours,

William F. Devane
Commissioner

WFD:k

EDDY valves and hydrants not only give the kind of service that Albany's Water Commissioner William F. Devane tells us about—but Eddy can supply repair parts for any and every valve they ever built.

It is important that future long-time service is a part of what you buy. When your municipality embarks on a waterworks modernization program make sure that the capacity and resources of your equipment supplier are such as to assure its maintenance—even for a hundred years.

That's why Eddy is a good company to do business with. Let us give you the facts and figures.

EDDY AWWA fire hydrants offer these advantages

They open smoothly with the pressure, close without water hammer. Entire operating mechanism is easily removed for inspection and repair *by one man.* Standpipe drains by automatic drip action.

EDDY has everything you need for underground water systems

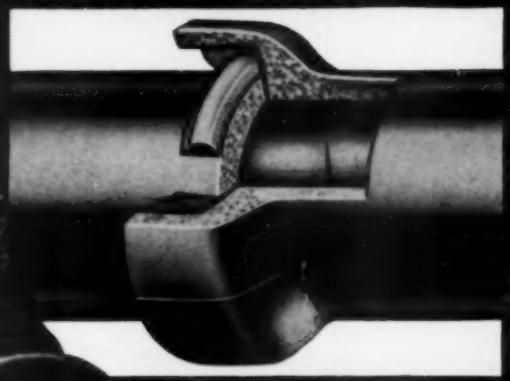
Quickly available are AWWA gate valves, cutting-in valves and sleeves, tapping valves and sleeves. Call your EDDY man for complete details.

EDDY VALVE COMPANY
A Subsidiary of James B. Clow & Sons, Inc.

WATERFORD NEW YORK

NEW **Wedge-Lock*** JOINTS

Greatest Contribution to Sanitary Engineering since Vitrified Clay Pipe



LIKE A RAILROAD COUPLING... WEDGE-LOCK JOINTS WEDGE IN! LOCK TIGHT! IN ONE SIMPLE, EASY OPERATION

When you want to set high performance standards . . . control infiltration to strict specifications and reducing pumping costs . . . handle root problems . . . insure completion of the job exactly as originally designed . . . maintain lower cost-in-place due to faster, easier installation . . . you'll call for the *best* factory-made joint. Bonded-on Wedge-Lock Joints go in as fast as the trench is dug . . . "snap" tight instantly, in continuous compression . . . last as long as the world's longest lasting pipe.

Always specify *Vitrified Clay Pipe*, with *Wedge-Lock Factory-Made Joints*. Write to listed manufacturers for literature or an actual Wedge-Lock demonstration.

*Patented . . . T.M. Reg. U.S. Pat. Off.

Wedge-Lock CLAY PIPE

THE FACTORY-JOINTED CLAY PIPE AVAILABLE NATIONALLY FROM LOCAL MANUFACTURERS

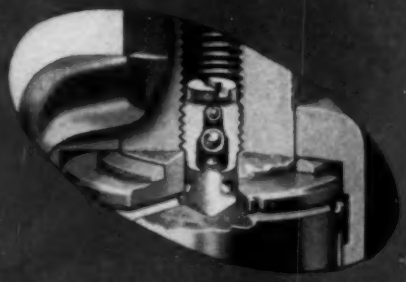
Order Wedge-Lock from any of these Vitrified Clay Pipe Manufacturers:

Cannelton Sewer Pipe Company, Cannelton, Ind.
Clay City Pipe Company, Uhrichsville, Ohio
The Evans Pipe Company, Uhrichsville, O.
Gladding, McBean & Company, Los Angeles 54, Cal. *(Sold under trade name, "SPEED-SEAL")*
The Logan Clay Products Company, Logan, Ohio
Oconee Clay Products Company, Milledgeville, Ga.
Pacific Clay Products, Los Angeles 54, Calif.
Pine Hall Brick & Pipe Company, Winston-Salem, N.C.
Pomona Terra-Cotta Company, Greensboro, N.C.
The Robinson Clay Product Company, Akron 9, Ohio
The Stillwater Clay Products Company, Cleveland 16, Ohio

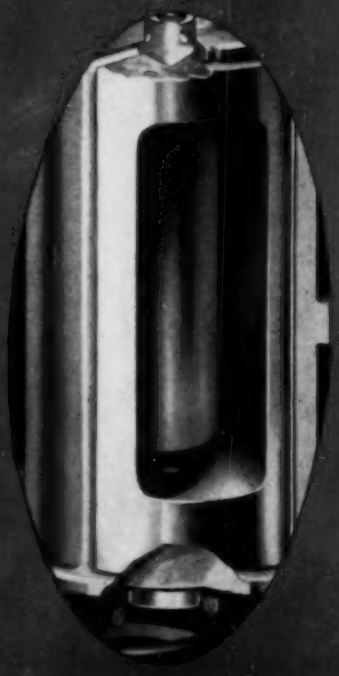
WLC-258-58

In the spots that count...Homestead Valves are

LEAKPROOF



Reinforced Teflon and lubricant seal



Controlled pressurized lubricant seal

Lower cost per year valve service is guaranteed by Homestead Lubricated Plug Valves. These are the features that make them leakproof and extend their useful life . . . reinforced Teflon* head seal, double ball and lubricant sealed check valve, and their exclusive controlled pressurized lubricant seal.

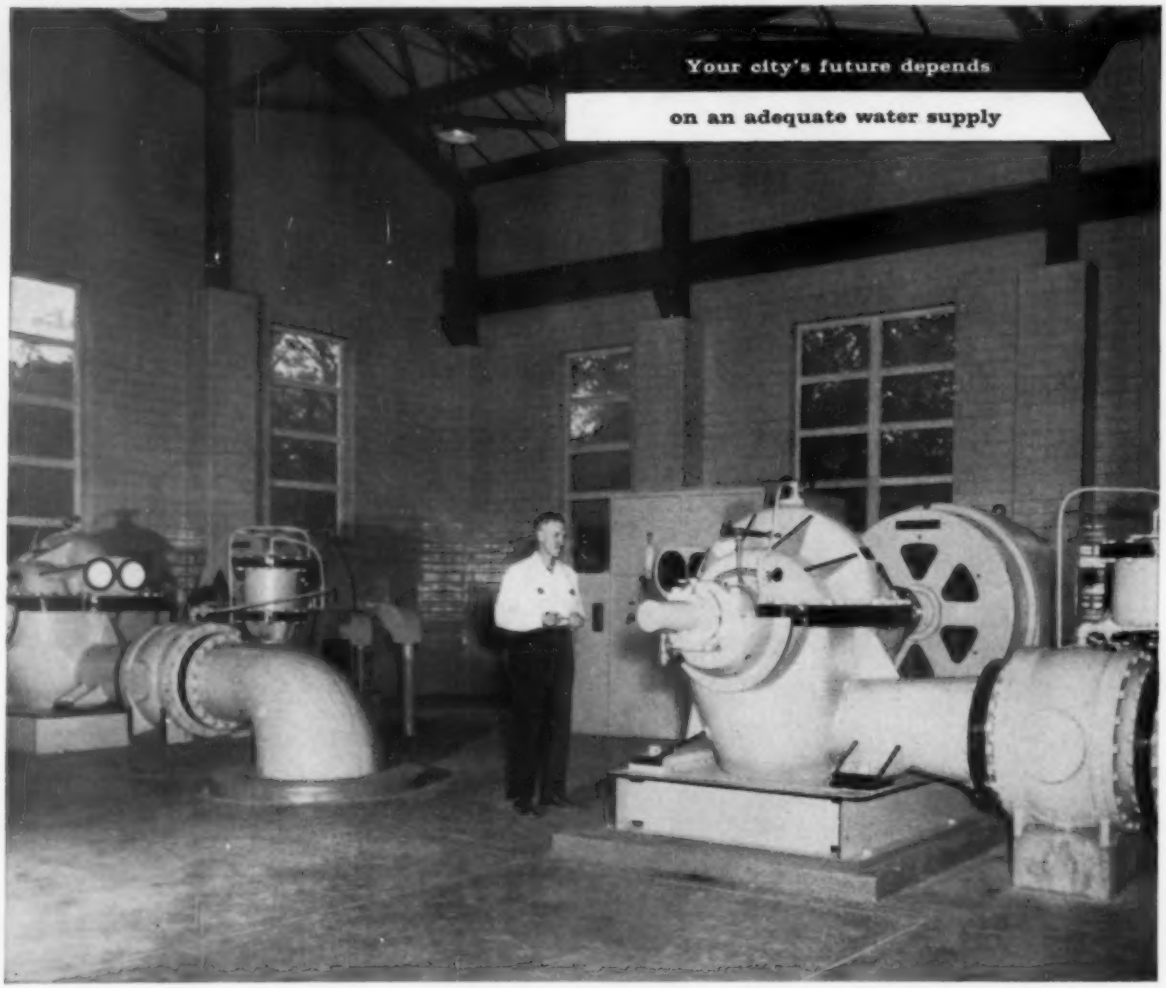
Homestead's controlled lubricating system forces a chemical film over all sealing surfaces at more than 300 pounds pressure. In addition, it prevents sticking, by its piston-like movement of the plug during each lubrication. See how Homestead fills your valve needs. Write today for Reference Book 39, (Section 5), for complete information on Homestead Lubricated Plug Valves.

*DuPont registered trademark.

h
v

HOMESTEAD VALVE MANUFACTURING COMPANY

P. O. Box 42 • Coraopolis, Pa.



At Omaha's new Turner Boulevard Station, two F-M 25 mgd. pumps driven by 700 hp. F-M motors handle 48% of the booster pressure system.

How Omaha puts the sure in pressure

A city of hills, Omaha, Neb., had to repump over 16,000,000,000 gallons of water last year —more than 75% of its total supply.

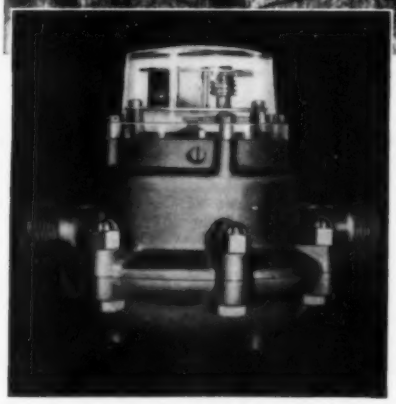
As the base-load station in this booster system, Metropolitan Utilities District engineers designed the new Turner Boulevard Pumping Station. Here, two automatically controlled Fairbanks-Morse centrifugal pumps, with 50 mgd. combined capacity, handle 48% of the requirements.

Like most progressive cities and towns these days, Omaha is making sure its water facilities match population and consumption growth. Your Fairbanks-Morse Sales Engineer will help you do the same, by working with your own engineers on either water supply or water disposal programs. Write Fairbanks, Morse & Co., Dept. 0000, 600 So. Michigan Avenue, Chicago 5, Illinois.

Ask for F-M Bulletin 5810A on Centrifugal Pumps.

FAIRBANKS-MORSE
a name worth remembering when you want the BEST

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME WATER SERVICE EQUIPMENT • MAGNETOS



Use American Meters with sealed plastic register box for pit installation.

METER DEPARTMENT FOREMAN

Boss of Installation and Maintenance

He says, "Dependable American Meters require so little attention, that we have more time for the efficient maintenance of other equipment."

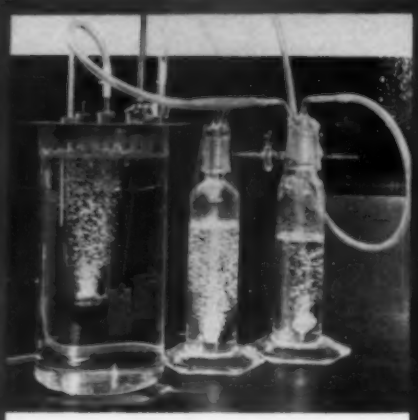
He bases his statement on experience. He has found that American Meters are simplest in design and construction. The interior parts are rugged and have proper clearances that resist failure caused by small amounts of foreign material in the water. Precision manufacture assures that all parts — even chamber halves — are fully interchangeable, to simplify parts stocks and reduce maintenance costs.

He doesn't want his meter department bogged down with meter repairs . . . that's why he recommends American!

BUFFALO METER CO.

2909 Main Street • Buffalo 14, New York

1 Analytical weighing of specimens prior to testing



2 Steam condensate corrosion test

3 Cleaning specimens with inhibited hydrochloric acid

4 Second analytical weighing to determine corrosion weight loss

5 Calculation and statistical analysis of laboratory test results

6 Final examination of specimens under low power magnification

Extensive testing program proves new 4-D Wrought Iron more corrosion-resistant than ferrous substitutes

Test results from the Byers Research Laboratory lend documentary support to the superiority of new 4-D Wrought Iron—over standard Wrought Iron as well as ferrous substitutes.

Convincing case-history service records are now further substantiated by the conclusive findings of our metallurgical staff. Some typical results of this testing program are presented in the chart at right.

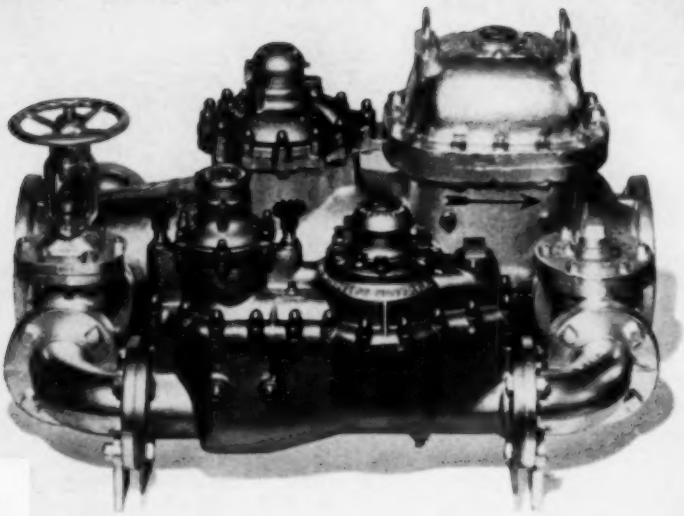
The Byers field service representative will be pleased to relate these test results to your corrosive applications. Write us for helpful literature on new 4-D Wrought Iron. A. M. Byers Company, Clark Building, Pittsburgh 22, Pennsylvania.

BYERS WROUGHT IRON

Comparative Analysis of 4-D Wrought Iron Corrosion Tests

Tests	4-D Wrought Iron	Standard Wrought Iron	Ferrous Substitutes
Severe industrial atmospheric continued exposure 17 years	Corrosion weight loss 540 grams/sq. ft.	Corrosion weight loss 655 grams/sq. ft.	Not included in test
Steam condensate return line	*At least 25% greater corrosion-resistance than standard Wrought Iron	No failures 10 years (still in service)	Complete failure after 2 years
Aerated salt water—5 weeks (Short term test—points indicate 4-D Wrought Iron curve flattening out at much lower rate of attack)	Corrosion weight loss 146 mg/sq. in.	Corrosion weight loss 170 mg/sq. in.	Corrosion wt. loss 226 mg/sq. in.
Brine piping	*At least 25% greater corrosion-resistance than standard Wrought Iron	No failures 23 years (still in service)	Complete failure after 7 years
Salt water, Gulf of Mexico ¼ inch plate—17 years	Corrosion weight loss 4 mills/years (minimum plate thickness now $\frac{3}{16}$") Still in excellent condition	Not included in test	Corrosion weight loss 30 mills/years; plate badly pitted, perforated
Downspout	*At least 25% greater corrosion-resistance than standard Wrought Iron	No failures in 29 years (Still in service)	Complete failure after 18 years

*In this application no long term test data yet available on 4-D Wrought Iron. Results shown are derived from short term tests.



Model FM-CT
Water Meter
Sizes 4″-10″
Inclusive

Nothing has yet been produced that equals the

HERSEY DETECTOR (Fire Service) **METER**

for measuring all rates of flow for Domestic-Industrial and Fire service lines.

Send for circular giving full details

HERSEY MANUFACTURING COMPANY

DEDHAM, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA — DALLAS — CHICAGO
SAN FRANCISCO — LOS ANGELES

C. C. CONDON, Superintendent of the New Brunswick, N. J. Waterworks,* tells:

"How we increased our peak load capacity with porous underdrains:

"With our old graded-gravel filters, we couldn't always get the volume we wanted. Backwashing was frequent and usually on an emergency basis. Mudballs were common, too. In 1946 we started a year-and-a-half test of an ALOXITE® aluminum oxide bottom, using Anthrafilt for the filter media. This was so successful that now all eight of our gravity filters have ALOXITE bottoms. The other eight are pressure filters.

"Our volume has jumped from our former peak-load limit of 1½ MGD to 2½ MGD. Five filters with ALOXITE plates can do the job that used to keep eight busy. So we have far greater flexibility. And our backwashing is done on schedule now—not irregularly as before. It takes just 12 minutes every 24 hours.

"Getting rid of clogged bottoms has also cut cleaning costs. Water is better too—in fact, even though we use raw water and mix the filtered water from both the gravity and pressure systems, we still show a hardness of 62 PPM, acidity of 2 PPM, and turbidity of 2.5 PPM.

"Our only problem has been corners breaking on our #7 filter. We traced this to the use of overly-thin washers which allowed a little play. But this will be easy enough to cure."

The Carborundum Company, Refractories Division, Perth Amboy, N. J., Dept. X-58.

*Mr. Luke Horvath is Commissioner of Water, and Mr. Thomas F. Boylan is General Superintendent.

CARBORUNDUM
Registered Trade Mark

"That's a smart question, son . . . and the answer is 'experience'."

Inside every Ludlow fire hydrant and every Rensselaer fire hydrant you'll find working and structural parts — developed through nearly 100 years of sound experience — that fill these four basic requirements for a perfect hydrant:

SIMPLICITY OF DESIGN AND OPERATION

ABSOLUTELY TIGHT CLOSURE

NO FREEZING

NO FLOODING DUE TO STANDPIPE BREAKAGE

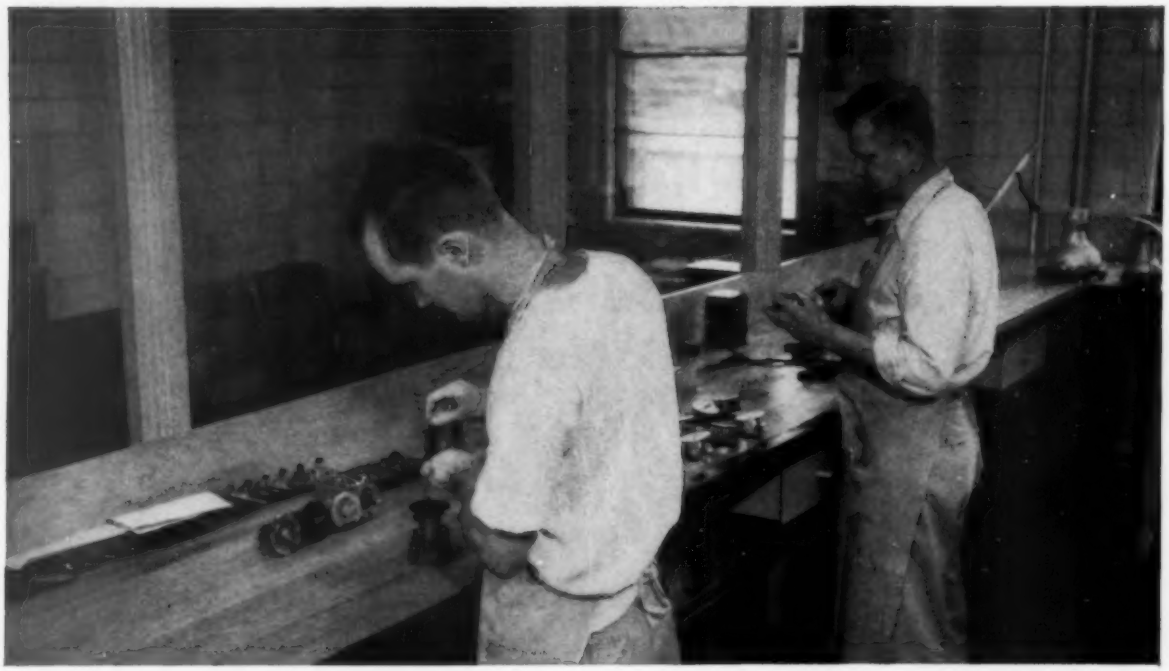
All Ludlow and Rensselaer hydrants are built for easy, dependable operation and long life, despite rough treatment and the most severe climate conditions. They're engineered for *performance* and meet all A.W.W.A. specifications. That's why they've been "watchdogs" of American property since 1861!

WRITE TODAY — for the L&R Fire Hydrant Catalogs, which show a model for every need.

LUDLOW & RENSSELAER

VALVES AND HYDRANTS

THE LUDLOW VALVE MANUFACTURING CO., INC., TROY, N. Y.–SINCE 1861



Do you have AUTOMATIC MODERNIZATION in your water system?

If you have Trident water meters, your department is probably the only service in your community equipped with *Automatic Modernization* . . . a process which costs far less than "scrap and replace" programs.

Every time you replace work-worn parts in a Trident disc meter, you automatically use modern parts identical to those in the *latest* model . . . parts embodying every thoroughly tested advancement known to the science of metering.

No need to keep complicated stocks of parts for many models . . . just keep a small stock of modern parts. It's easier to train service men, too. Your men need learn only one simple, fool-proof model, and they can service all.

Designing modern Trident parts so they'll fit "old" meters has been a rigid Neptune policy for 60 years. *Every design improvement now on our drawing boards will continue this policy.*

It's your best assurance that the meters you buy today will continue to earn more and cost less for many decades to come.

This year's up-to-date parts make "modernization kit" for 17 million Tridents.

neptune
TRIDENT WATER METERS

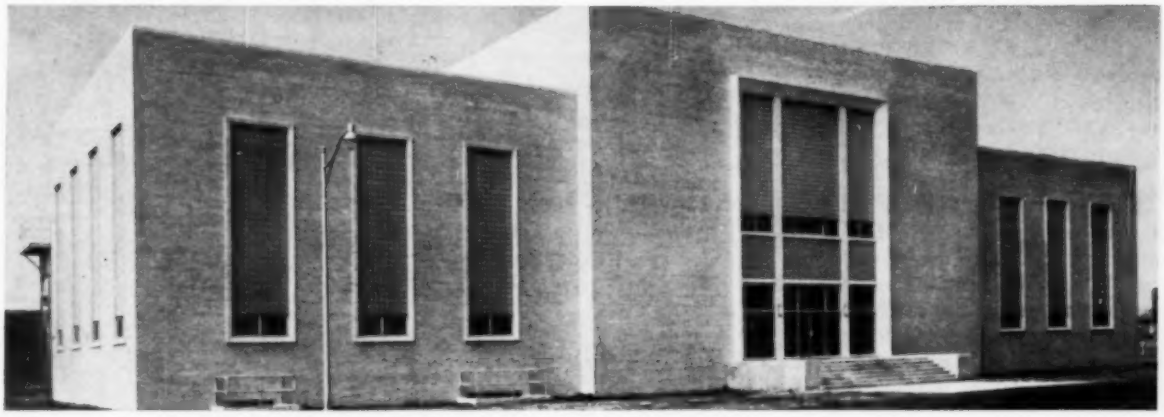
NEPTUNE METER COMPANY
19 West 50th Street
New York 20, N. Y.

NEPTUNE METERS, LTD.
1430 Lakeshore Rd.
Toronto 14, Ont.
Branch Offices in Principal American and Canadian Cities.

Vol. 105, No. 5 · May, 1958

WATER & SEWAGE WORKS

A Scranton Gillette Publication



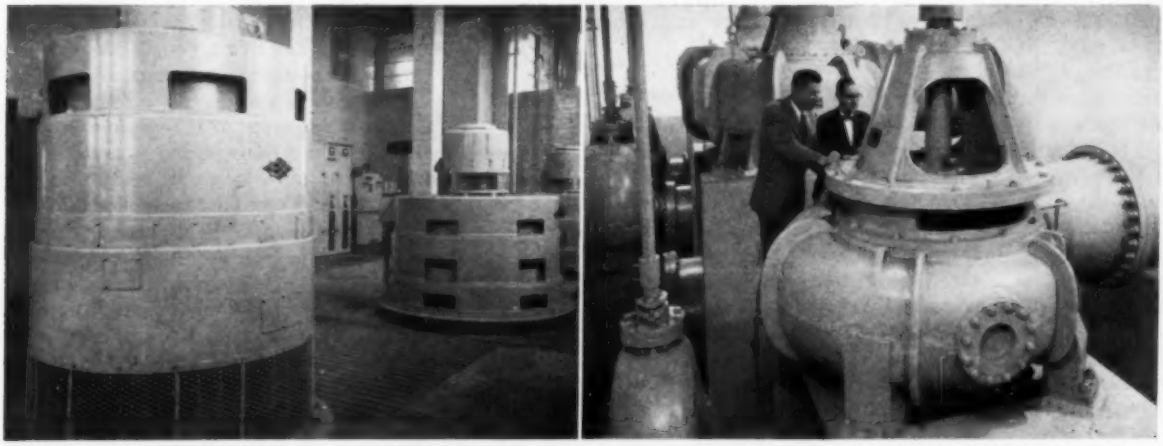
AN ATTRACTIVELY DESIGNED operations building (one of two) houses modern sewage treatment equipment for the . . .

JERSEY CITY *pollution abatement facilities*

By DAVID L. GALLAGHER, Manager, Public Works Dept. Worthington Corporation, Harrison, N. J.

EDITOR'S NOTE: When we learned that Mr. Gallagher was preparing an article on the Jersey City sewage treatment plants for his company house organ "Power and Fluids", we asked him to submit a copy to us with the thought that it might also be of interest to a wider audience. The following article is a condensed version of the original.

■ THIRTEEN YEARS AGO, preliminary surveys were started in Jersey City, N. J., to prevent pollution of the harbor waters. Those efforts were culminated in July 1957 when two new sewage treatment plants went into operation to handle the municipal waste load from that city. The extent of the pollution load is pictured graphically in Fig. 1, which shows the pollution of the surrounding waters.



MAGNETIC DRIVE MOTORS power variable speed raw sewage pumps through vertical shafts. Size of pumps is indicated by the author (right) and associate inspecting the installation.

In 1949, the Jersey City Sewerage Authority was established by Jersey City to finance and construct the necessary sewage disposal system. Since that time, several alternate plans were suggested and studied to determine the most satisfactory and economical system for collecting and treating Jersey City's wastes. Final plans, as prepared by Clyde Potts Associates, engineers in New York City, were approved and bids were taken in 1953, on a two-plant system, with plant cost about $17,000,000.

Jersey City, a city of over 300,000 population, is situated on the west bank of the Hudson River across from lower Manhattan. While the Hudson River provides the eastern boundary of the city, the Hackensack River and Newark Bay bound it on the west. Actually Jersey City is situated on a ridge of land running north and south. This separates the city into two slopes and natural drainage areas. Sewage and storm water flow by gravity to one of the two plants which are located midway of the interceptors.

The Interstate Sanitation Commission, created by the States of New Jersey, New York and Connecticut, is responsible for the prevention of pollution in the Metropolitan area. Jersey City is in a Class "B" zone, which zone requires the removal of all floating solids and at least 10 per cent of the suspended solids together with such reduction in biochemical oxygen demand as is needed to maintain the dissolved oxygen content in the receiving waters at more than 30 per cent saturation. These desired ends are accomplished by primary sewage treatment. The West Side Plant is designed for a plant capacity of 36 mgd and the East Side Plant for 46.62 mgd. The West Side plant is situated on the Hackensack River bank, while the East Side Plant is on the Hudson River bank.

The unique feature of the Jersey City Sewage System is that the sludge from the East Side plant is pumped to the West Side plant through a Jersey Central Railroad right-of-way acquired by the Authority, connecting the two plants. Electricity generated from the sludge gas in the West Side plant is transmitted over power lines on the same right-of-way to the East Side plant, where it provides power for the entire plant. Major uses of the power are raw sewage pumping and sludge pumping.

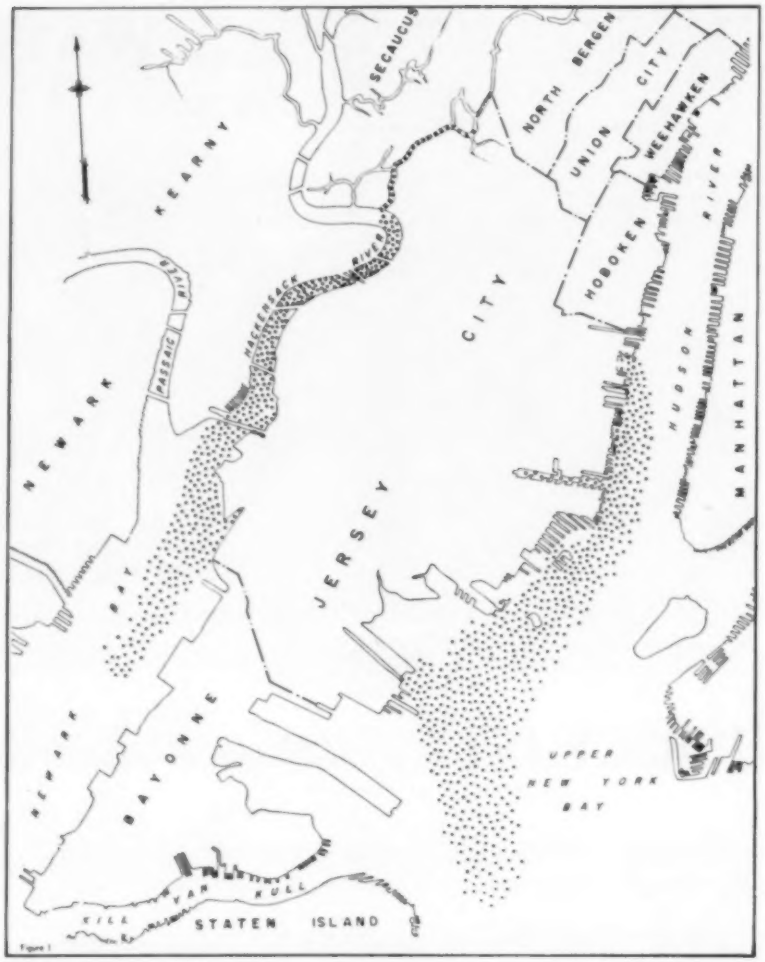


Fig. 1—SEWAGE SOLID LOAD from Jersey City, before treatment, is indicated in this map of surrounding waters by dots, each of which represents 100 lb per day of dry solids.

Both plants have mechanically cleaned screens and grit chambers ahead of the main sewage pumps, which will materially reduce maintenance and prolong the life of the pumps.

Plant Equipment

The plant units are listed in Table 1. Of particular interest are the raw sewage pumps and motors. All pumps are of the vertical mixedflo type. In the East plant, two are 36-in., 32 mgd pumps driven by 250 hp, 400 rpm magnetic drive motors and two are 42-in., 64 mgd pumps driven by 500 hp, 300 rpm motors. All four pumps are designed to operate against a head of 35 feet. Casings are of cast iron with cast iron impeller, bronze wearing rings, bronze shaft sleeves, grease lubricated ball bearings and steel shafts. Pumps are installed on the bottom floor to eliminate suction lift, and are connected by vertical shafting and flexible couplings to motors on upper floor.

The two 32 mgd pumps are variable speed units (magnetic drive) so they are operated automatically at the speed which exactly meets the flow requirements of the sewage influent. The two 64 mgd pumps are constant speed units to handle peak and storm flows. Pumps are controlled by a specially designed float control to permit recycling. (See accompanying photo.)

In the West Side plant there are four pumps, two 24-in with a capacity of 25 mgd each, driven though vertical shafting by 150 hp, 600 rpm motors and magnetic drives; one 30-in. pump 40 mgd, 300 hp, 450 rpm units, and one 36-in. pump 30 mgd, 380 hp, 400 rpm unit.

In an accompanying illustration the

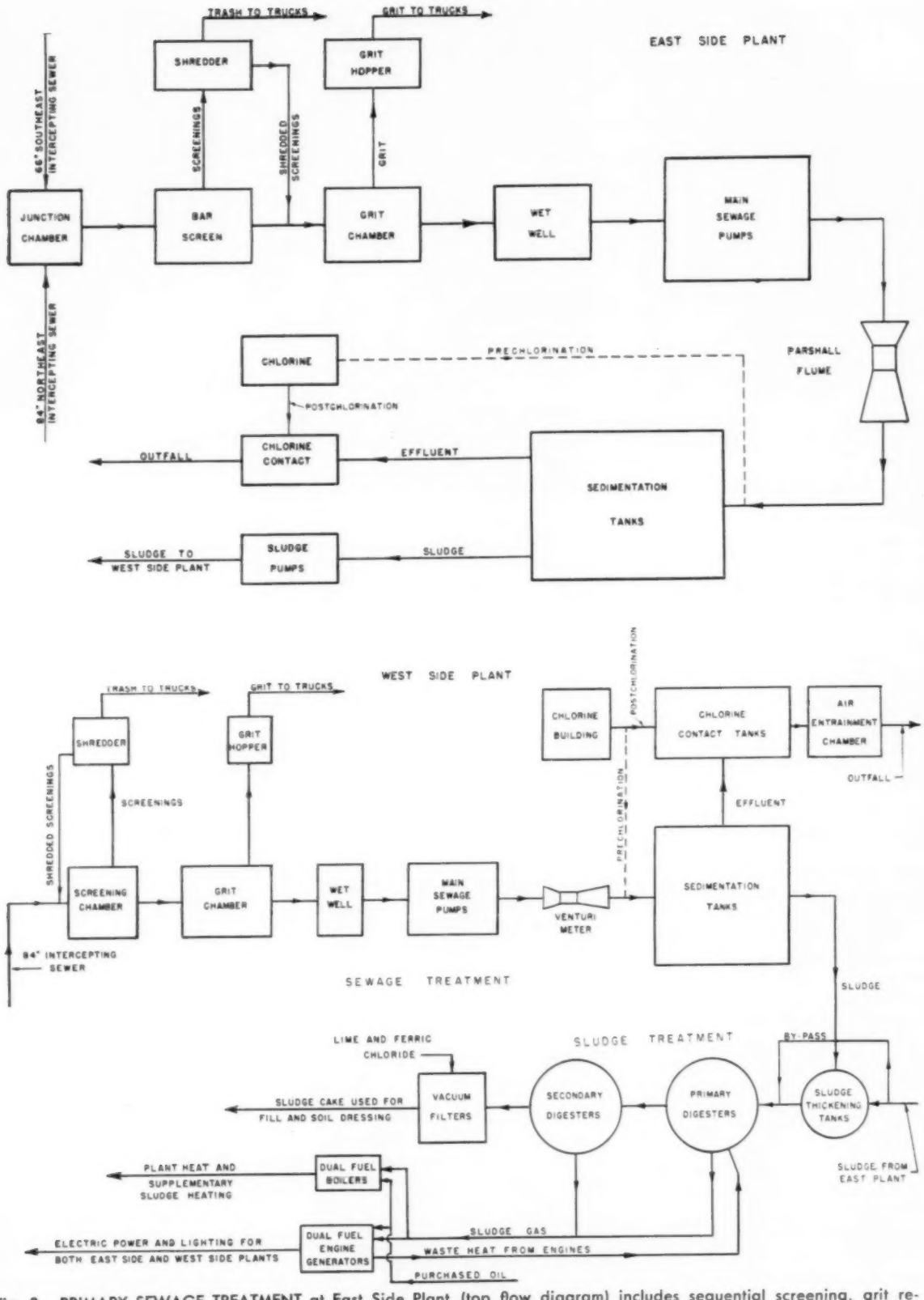


Fig. 2—PRIMARY SEWAGE TREATMENT at East Side Plant (top flow diagram) includes sequential screening, grit removal, pumping, flow measurement, sedimentation, sludge removal, and effluent chlorination. West Side Plant (bottom diagram) includes the same process plus sludge digestion and sludge disposal.

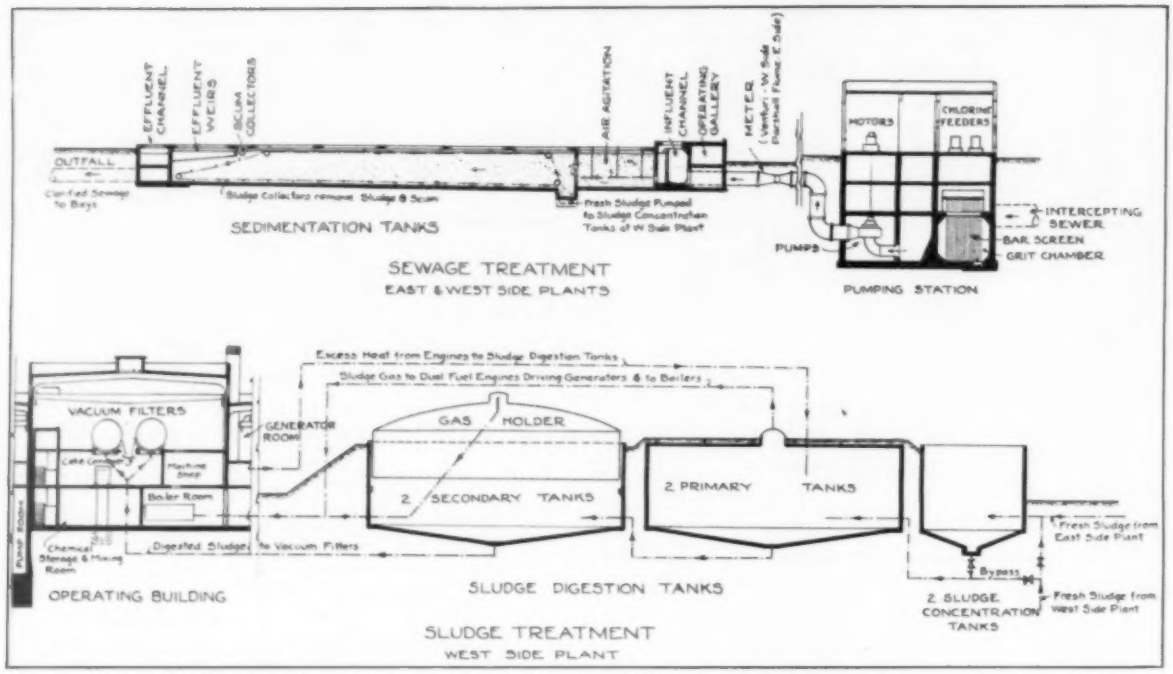


Fig. 3—THE DESIGN PROFILE for primary treatment process (top) shows gravity flow of raw sewage to pump section. Two stage digestion design profile (bottom) allows for gravity flow of sludge from second stage digesters to vacuum filter building. Raw sludge from East Side Plant is concentrated before being added to first stage digestion tanks.

motor floor is showing the motors in the foreground including magnetic drive. All four pumps are designed to operate against a head of 33 feet. Materials of construction are the same as the East Side pumps, except pump suction elbows are made of formed concrete, not cast iron.

As in the case of the East Side plant, two pumps are variable speed units (25 mgd) that are controlled automatically by the float controller to exactly handle the incoming influent flows. The 40 and 50 mgd units are to handle peak and storm flows.

Sewage flow is measured through a venturi meter at the East Side and a Parshall flume at the West Side. These tanks are equipped with sludge and scum removal equipment to collect the floating and settled solids. Pneumatic ejectors remove the fresh solids at a controlled slow rate. Collected fresh sludge from both plants is pumped to the sludge thickening tanks at the West Side plant. The clarified effluent from the East Side plant is treated with chlorine, and flows by gravity to the Hudson River. Clarified effluent from the West plant is treated with chlorine and flows by gravity to Newark Bay. The flow diagrams of both East and West plants are shown in Fig. 2 and the profile of the plants in Fig. 3.

Sludge Digestion

In addition to the equipment outlined for the East Side plant and the sludge thickening tanks just mentioned, the West Side plant also has primary digesters, secondary digesters, vacuum filters, dual fuel boilers and dual fuel engines and generators.

There are two first digester tanks with fixed roofs and two second stage digesters with floating roofs. Digested sludge is dried on the vacuum filters and the sludge cake goes to a storage bin and is then trucked away to use for soil dressing, or fill.

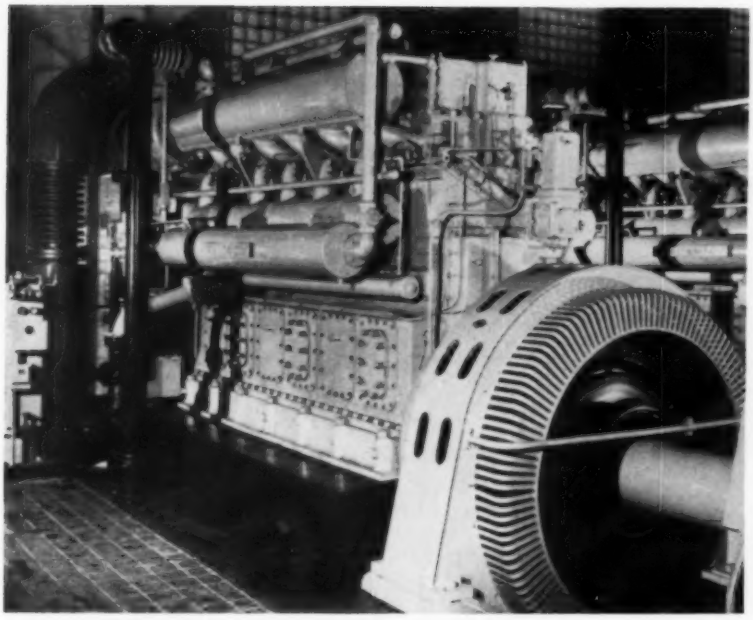
Gas from the digesters, is collected above the second stage tanks. This gas is used to heat the dual fuel boilers and for power generation. The sewage sludge gas comes from the digester tanks at approximately 3½ in. water pressure. Two horizontal water cooled gas booster compressors boost the gas to 30-pound pressure in three vertical gas receivers. Each compressor is designed to handle 223 cfm and is driven through a Multi V drive by a 25 hp, 1800 rpm totally enclosed fan cooled motor.

Dual Fuel Engine Generators

From the receivers the gas is used as the fuel for three (3) supercharged dual fuel engines which are direct connected three 693 kw generators. They provide all the power necessary to operate both the East and the West Side plants. These are 6-cylinder engines with a bore of 13¼ in. and stroke of 17½ in. They are of the 4-cycle high compression or diesel type, single acting, vertical multi-cylinder, trunk piston design with a brake M.E.P. of 120 psi. The piston speed is 1312 feet per minute. Each engine is rated 990 hp at 450 rpm, and weighs approximately 35 tons. The generators are each 866.2 kva, .8 power factor, 450 rpm, 3 phase, 60 cycle, 4160 volt, 50 deg. C rise, with direct connected 15 kw, 125 volt, 1750 rpm belted exciters.

Since these are dual fuel engines they can generate power on fuel oil in starting up the plant prior to sewage gas being available, or if gas production should fail. They are designed to operate on proportion of oil and gas from 94 per cent sewage sludge gas and 6 per cent pilot oil to 100 per cent fuel oil. Upon failure, or lessening of the gas supply, the engines automatically increase the fuel oil sufficient to maintain the speed and load.

Fuel oil is pumped from three 200 gallon oil service tanks by rotary



DUAL FUEL ENGINES operating on from zero to 94 per cent sludge gas drive generators which produce all the electric power required at both plants.

TABLE 1

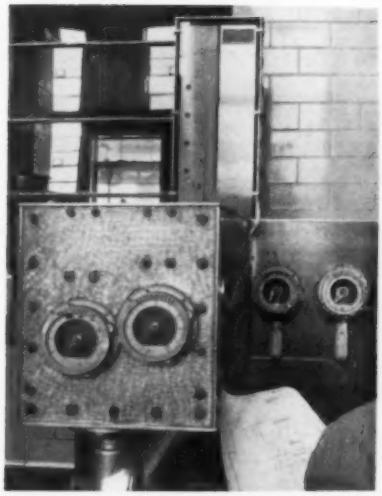
Treatment Plant Units

	East Plant	West Plant
Plant Capacity		
million gallons per day	46.62	36
Raw Sewage Pumps*	2—32 mgd—250 hp 2—64 mgd—500 hp	2—25 mgd—150 hp 1—40 mgd—300 hp 1—30 mgd—380 hp
Sedimentation Tanks		
Number of Tanks	6	5
Length of Tanks	160 ft.	150 ft.
Width of Tanks	66 ft.—6 in.	66 ft.—6 in.
Depth	14 ft.	14 ft.
No. of longitudinal collectors in each tank	4	4
No. of cross collectors in each tank	1	1
Retention period—hours	3	3
Sludge Concentration Tanks		
Number of Tanks	....	2
Diameter—feet	....	40
Depth—feet	....	35
Sludge Digestion Tanks**		
No. of Tanks	....	4
Diameter—feet	....	100
Depth Wall—feet	....	32
Power		
Engine & Generators	....	3
Engine—Type	....	Dual-fuel Diesel
Horse power	....	990
Generators—KW (0.8 P.F.)	....	690
Generators—voltage	....	4160

*All pumps are Worthington vertical mixedflo pumps driven through vertical shafts by Electric Machinery Co. motors. E-M magnetic drives are used on two pumps in each plant. Worthington Corp. also furnished two 10x9 HB horizontal gas booster compressors, three SDLGO-6 supercharged dual fuel engines connected to Electric Machinery generators, fuel oil pumps, air compressors for engine starting, and engine cooling water pumps.

**Two of the digestion tanks have fixed covers and mixers for circulating the sludge and the other two tanks have floating gas holder covers which will store the collected gas.

Four 11½x13 ft. spring type vacuum filters in the Operating Building will be used for drying the Digested Sludge which will provide an excellent soil dressing.



SPECIAL DESIGN float control permits recycling in pump operations.

pumps, through Worthington-Gamon fuel oil meters. Lube oil is pumped from two 550 gallon storage tanks by rotary pumps. The starting air system for starting the engine consists of two Worthington air compressors, a motor driven unit and a gasoline engine driven unit. There are three 36 x 90 in. vertical air starting tanks. Jacket cooling water for the engines is pumped by three centrifugal pumps.

A Laymans Explanation of the Water Problem

The League of Women Voters of the United States has recently published a booklet entitled "On the Water Front".

This excellent booklet should aid in making great strides toward a nationl understanding of our present day water supply problems.

Divided into nine main sections, the booklet discusses: The Water Problem; The World of Water; Problems in Government; Too Much Water—The Flood Problem; Too Little Water—The Irrigation Problem; Clean Water—The Pollution Problem; Who Pays the Bill?—The Repavement Problem; What's Ahead—Problems of the Future; and Much Talk—Little Agreement.

Also included in the booklet is a discussion guide, glossary, and a list of suggested reading matter.

The publication, No. 242, is available from The League of Women Voters of the United States, 1026 17th Street, N.W., Washington 6, D. C. at a cost of 25 cents per copy.

Whether money is wasted or saved depends on proper planning and execution of operations in . . .

Water Tank Maintenance

by KEN W. ALTIZER, Vice-President of the Steel and Tank Service Co. of Charlotte, North Carolina. In this article he presents some sound arguments on the need for proper maintenance of elevated storage tanks.

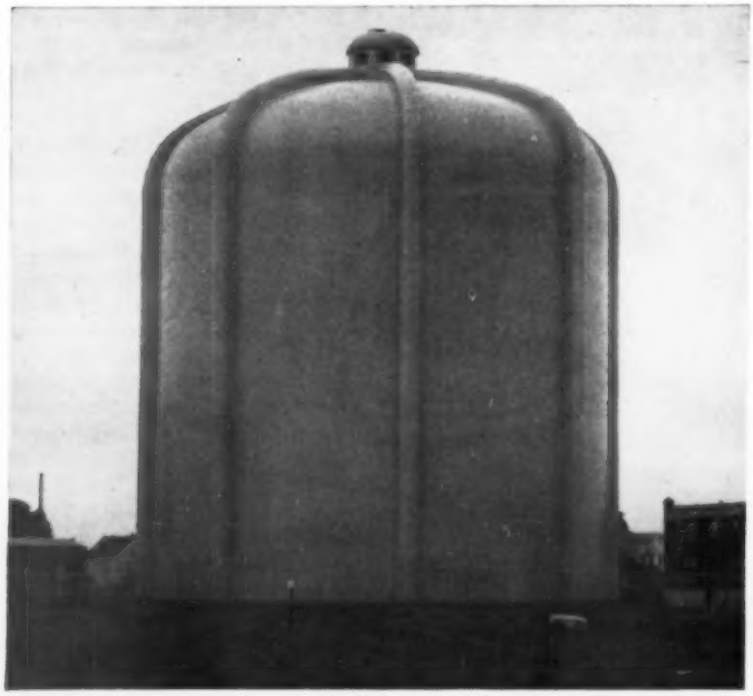
■ THE WATER WORKS INDUSTRY is one of America's largest industries, representing a capital investment of approximately $7½ billion and pumping more than 14 billion gallons (60 million tons) of safe drinking water per day. Furthermore, the annual tonnage production of the water works industry is about eight times as large as the combined output of *all other* industries now serving our population. This paper discusses in non-technical terms the maintenance of some of the equipment required in this industry that is in operation 365 days a year.

Water tanks and their maintenance can be one of the most troublesome problems with which water works men have to deal. Water tank maintenance can also be one of the most expensive items in the water department budget. Yet, if handled properly, it can create a savings. Water tanks are an essential and vital part of virtually every water system. Yet they should not be considered as a necessary evil.

What can be done to assure the city or company of proper maintenance at the lowest possible cost? It is the purpose of this paper to show how a saving can be created in a water tank maintenance program. By pointing out a few of the basic items that must be considered and acted upon if one expects to be successful in reducing this cost.

It is contended that the subjects contained herein are all that should be taken into consideration. On the contrary, there are others to be considered and the nature of some of them would not permit their discussion here.

Ed. Note: This paper, presented before the Virginia Section of the Am. Water Works Assn., has been released for publication in *Water & Sewage Works*.



ELEVATED storage standpipe (3,000,000 gal) at Philadelphia Suburban Water Co., Clifton Heights, Pa.

Inspections Are Important

To begin with, every water tank, regardless of its size and design, should be thoroughly inspected systematically. Under most conditions, a two-year inspection is adequate; in some cases, three or four-year inspections are sufficient. In any event, the inspections should be regular and systematic.

Be prepared to empty the tank as this is extremely important, being the only way the interior surface can be properly inspected. Interior inspection is extremely important because the interior surfaces generally need service more often than do the exterior surfaces. Then too, the exterior surfaces are seen daily by hundreds (and in some cases thousands) of people. For this reason, if none other, it is not often that the exterior surfaces are allowed to go too long without attention. Although water tanks need repainting frequently, if properly maintained repairs are rarely necessary.

It is better to lose a tank of water to get a complete and thorough inspection than to spend many times

more for the loss of steel brought on by rust and corrosion.

If there is not some in the organization who will climb and is qualified to inspect the tanks, then some other capable person should be engaged. In some cases, it may be necessary to pay for this inspection, yet if a good inspection is performed by an honest and reliable tank maintenance man, it will prove very inexpensive in the long run. If the inspection discloses the tank to be in need of service, then it should be done at the earliest possible date. Water tank maintenance is much less expensive than repairs or replacements.

Specifications

This entire paper could be devoted to specifications and then it would only be touching the surface. A good maintenance program requires expenditure of enough money for good materials and good labor. It either is lacking, the maintenance program is inadequate.

How about detailed specifications? The following deals with the type of cleaning, application, and material that has proven successful and has been doing a good job through years of service. When names of manufacturers and brands of materials are mentioned, it is merely for identification. The author has no interest in the sale of any product, except to see that good materials are specified to do the type of job required.

Preparation of the Surfaces

A maintenance job is no better than the all-important preparation of surfaces before the materials are applied. In 1952, an organization called Steel Structures Painting Council —made up of representatives and various steel fabricators, erectors, and contractors; railroad, highway department, and consulting engineers; paint manufacturers; commercial cleaning and painting contractors; and various other organizations— published a complete set of surface preparation specifications. They are now being used as a guide, in addition to the tentative recommended practices for painting and repairing elevated steel storage tanks, standpipes, and reservoirs, as published by the American Water Works Association.

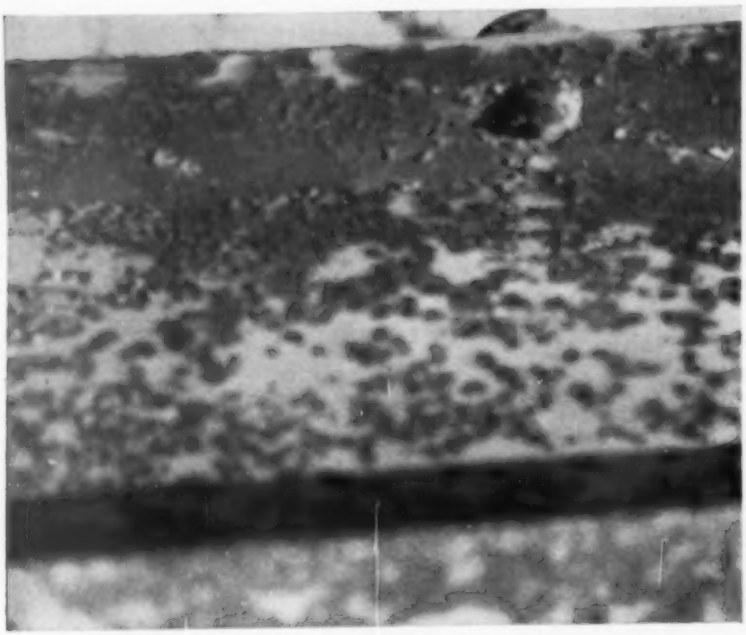
The advantages in using the surface preparation specifications of the Steel Structures Painting Council is that they are published in full detail. The specifications begin with hand tool cleaning and cover all types of cleaning, including white metal sandblasting, which is about as far as one can go with field surface preparation. The required type of cleaning should be properly specified when the specifications are being drawn up. If the structure is then to receive regular oil paint, the detailed specifications for the desired paint should be given. In some cases, it is not advisable to rely on the contractor to select the paint to be used. The American Water Works Association has prepared specifications for most of the commonly used conventional paints in their booklet mentioned previously.

STEEL water storage tank (137,000 gal) at Vest Station, Charlotte, N. C.

Coatings

To combat corrosion and condensation in water tanks, the field of plastics, after many years of research and development, stands ready today with time-proven systems of cold-applied, air-dried protective coatings. These coatings are odorless, tasteless, chemically inert, and resistant to cold mineral acids. They are unaffected by alkalies, impervious to oils, fats, gasoline, and mineral salts and are insoluble in alcohol and water. They adhere tightly over well-prepared surfaces of steel, concrete, or wood, and present a smooth surface in colors that may well fit into any color scheme. They will withstand a remarkable amount of abrasion, yet are plastic enough not to crack, chip, or fracture. Thus, an effective means of corrosion control for a large number of water tanks is believed to have been found.

Corrosion takes place because free metal is chemically unstable. Steel and iron are highly susceptible to corrosion and almost all acids, alkalies, and salts used in the water works industry are highly corrosive. The proper vinyls are excellent in handling this corrosion and are easily



RUSTED interior of water tank before painting at Town Ramseur, N. C.

applied by skilled and competent workmen.

Almost all disadvantages in using vinyls are tied in with their application, they just will not work unless they are put on properly. However, their bonding is excellent if they are applied properly; they are extremely tough, and have long useful life.

An inorganic zinc coating applied cold and leaving a galvanized effect is doing an excellent job on the interior of water tanks. The Dimetcote project, manufactured by Amercoat Corporation, is being used by many for this protection. The Commonwealth of Virginia has been using it quite extensively during the past several years on the interior of water storage tanks at state hospitals, prison farms, and other locations. The coating is not a paint. It does not contain oils, resin, or other organic materials, yet it can be applied with conventional spray equipment. When applied to steel, it bonds chemically as well as physically. Dimetcote shows no physical change after more than 14 years of exposure to the most severe weather conditions. An electro-chemical reaction between the zinc in the coating and the steel surface will cathodically prevent rusting. As with other coatings the product must be applied properly to get proper protection.

Metallizing, a process for spraying molten metal on properly prepared steel surfaces, has been successfully employed in Europe since the early 1920's. Its use in America dates back to the early 1930's. It has a proven record on the interior of water tanks.

For metallizing it is necessary that the steel be cleaned with pressure blast using special abrasives. Corrosion-resistant coatings of zinc or aluminum are porous, yet they offer protection by electrochemical action. Some systems of metal spray call for a finish coating of vinyls. This, of course, leaves a very smooth finish. Among the records on sprayed metal is the case of the lock and dam gates on the Nermour River in Belgium, which were metal sprayed with zinc in 1926 and 1928. They are still in excellent condition.

Two 15,000-gallon gravity sprinkler tanks for the General Mills Company in Buffalo, N. Y., were metallized with zinc in 1934. These tanks were badly pitted, with 20 to 30 percent of the metal on the rivet heads rusted away at the time the application was made. The shell and head plates were deeply scored and pitted. The zinc coating in these tanks is still affording corrosion-free protection 22 years after the application.

There are other records of metal spray equally as impressive. Coatings of sprayed molten metal are affording excellent protection on exposure to heavy industrial atmosphere, salt atmosphere, and humid atmosphere. These coatings are "tailor made" and should be applied by skilled and experienced men in this field.

Red lead is commonly used as the prime and finish coats on the interior of water tanks. The second coat of red lead should have a phenolic resin base or litharge should be added to the red lead immediately before it is applied. Wax grease type coatings manufactured by Dearborn Chemical Co., Texas Company, and others, afford an acceptable interior coating and are quite commonly used. Several paint manufacturers make a bakelite product that does a good job on the interior of water tanks.

Quite frequently, water tanks are designed and the exteriors are painted to harmonize with the type of architectural styling existing in the neighborhood. They can be painted many different colors and combinations of colors.

In selecting the exterior material one should be just as specific on the surface preparation and application of the prime coat as on the interior surfaces. It is unwise to attempt to save money by purchasing cheap or inferior materials; materials represent a very small portion of the maintenance expenditure. Specify materials that have proven themselves through years of service.

There are other things to remember, also. Most coatings or paints should not be applied when the temperature is near freezing or is expected to be near freezing in a few hours. If thinner is required, be sure that the manufacturers recommended the type to be used. Have all of the materials shipped to the job site in factory-sealed containers and see that the manufacturer's recommendations are followed in their application.

Repairs

If repairs are needed they can and should be determined by a complete and thorough inspection. Have the tank emptied, as previously recommended, and the inspection made. But be sure repairs are necessary before they are bought. Then include them in detail in the specifications for the original contract.

There is seldom any reason for cost plus repair contracts, and no reason for making a contract to pay so much per lineal foot for welding or caulking. Do not enter into a contract to replace all rivets that are found to be needed for a set price per rivet. All repairs should be specified and contracted for at a total cost for the entire job. This is always more satisfactory to the tank owners. Repair work should not be done without a written agreement between the tank owner and the contractor.

If a tank is properly maintained, it will need very few repairs during its entire life. There are no moving parts to wear out, except where liquid level indicators are used, but tanks will deteriorate from rust and corrosion brought on by neglect.

Workmanship

One of the finest butchers the author has ever known supplies his family with beef. If a fine tender, juicy, sirloin steak is wanted, a phone call is made and the meat is supplied. This butcher wields the knife with such precision that unquestionably he could remove an appendix and would probably charge much less than a surgeon would.

On the same principle, water tanks could be serviced by a house or commercial painter at much less expense, in a great number of cases, than it would cost if done by a specialist. Just as with surgery, tank maintenance requires skill and experience. A large percentage of the cost of painting or repair work is represented by labor. But in the long run skilled labor or a specialist is much less expensive than unskilled and inexperienced labor.

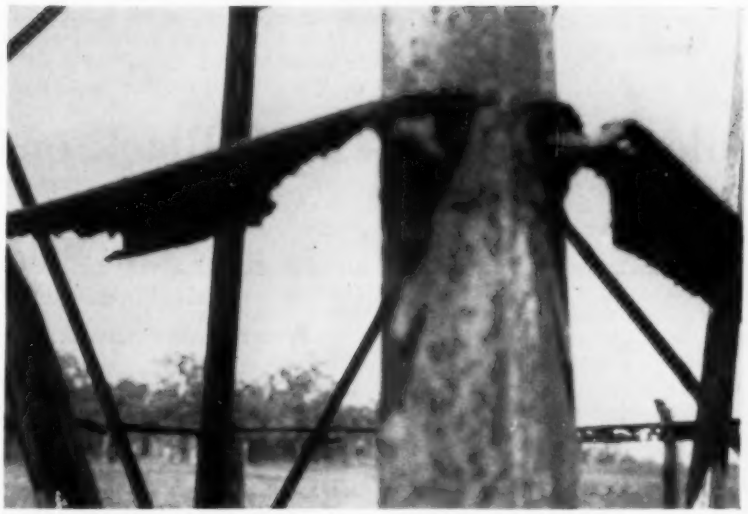
Most good water tank repairmen also are skilled painters. Yet, on the other hand, there are expert painters who are not schooled in repair work. Regardless of the job to be done on a water tank, it requires skill. Therefore a specialist should be employed. But skilled workmen must have good tools in order for them to perform a skilled operation.

The Contract

All important items should be covered in the contract. Specifications for cleaning, painting, and repair work, if needed, should be covered in detail.

Workmen's compensation, public liability, and property damage insurance should be included, giving the amounts of coverage required in public liability and property damage. It be advisable to specify a completion date, especially for the interior surfaces. It may also be desirable to have bonds and licenses covered in the contract. Certaintly all city, county, state and federal laws and licenses should be complied with.

All of the work done under the contract is to be subject to the inspection and approval of the owner's appointed inspector at all times. This phrase should always be included in a maintenance contract. Have an inspector who knows and understands steel maintenance and will be available and willing to climb and inspect the structure. Consult a qualified attorney for all of the legal matters. Include them all, because the contractor or his employees may not be as reliable or conscientious as had been anticipated.



NEGLECT does this to steel water tank towers.

Payment should be made in one check upon completion and acceptance of the job. It should not be necessary to make intermittent payments during the execution of the contract; unless, of course, it is a very large contract and would be spread over several months for completion.

Picking a Contractor

Picking a contractor can also become a real problem. Therefore, extreme care should be taken in making the selection. Does the contractor have enough financial backing to complete the job? Do he and his employees have the know-how and ability? Does he have enough good equipment to do the job as specified? Know of the contractor's past service record. Are his prices in line with other reliable contractors? Know about them before you enter into a contract. Find out about his record through a municipal association, the American Water Works Association, the builders of the tank, concerns or municipalities served by the contractor, and of course other ways.

All available references should be checked. Inquire of the people who are in a position to know. It does not cost anything to check, yet it may save thousands of dollars. If an honest and reliable contractor is picked, most duties and worries are taken care of before the work even starts.

Final Inspection

A number of the final inspection items were covered previously under the heading of "Inspection." When a tank is being serviced, an inspector should be on the job regularly while the job is in progress—one who is familiar with steel maintenance and can climb the structure. See that the money is not being wasted by making certain that a good job is being done and all specifications are being followed.

After the work has been apparently completed, a final inspection should be made to assure all parties concerned that the contract has been satisfactorily completed. This final inspection is in addition to the regular inspection made by the inspector during the execution of the job.

Because some of the things mentioned are not acted upon, millions of dollars are wasted each year. In a great number of cases, unscrupulous contractors benefit. In other instances steel is wasted because of the lack of proper maintenance.

Volumes could be written on each subject that has been discussed. Yet, the purpose of this paper is to give a brief outline for the proper maintenance of tanks. The reader must fill in his own details as they are needed.

Whatever the causes, or the effects on consumers, it is essential to good water works practice to eliminate . . .

Colored Water — Red, Black or Blue

by JOHN J. HAMILTON and MARTIN E. FLENTJE, respectively, Chemist and Chief Sanitary Engineer, American Water Works Service Co., Philadelphia, Pa.

ALTHOUGH THE TITLE of this paper may seem facetious, it should be understood that the authors do not consider at all funny the troubles associated with these types of waters. Red and black water are still the source of many consumer complaints, and the blue-greenish stains caused by waters aggressive to copper are far too common to be considered humorous. This paper reviews and discusses some experiences with such waters.

Causes and Corrections

By the term "red" water is generally meant the reddish-orange colored, somewhat turbid, clothes-staining water the consumers of public water systems get under certain conditions. Red water gets its nickname because it has suspended in it finely divided particles of iron rust in the oxidized, ferric state (Fe^{+++}). Such water generally has a total iron content of 2.0 ppm or over (some present as ferrous iron), it leaves an unsightly ring on the bath tub and stains on fixtures, and quite badly discolors clothes washed in it. Part of the staining of clothes is caused by the oxidation of the dissolved ferrous iron portion occurring through the use of a chlorine bleach solution.

Red water may be caused by sending an iron-bearing water to the distribution system without removing the iron, as may occur with an iron-bearing well water or with insufficient or incorrect treatment of a surface water containing acid mine wastes. As such waters absorb air, the iron is oxidized and the water becomes discolored.

More generally the cause of red water is the introduction of an aggressive, corrosive water into a system containing unlined cast-iron or steel pipe. Red water may also follow mechanical cleaning of iron or steel mains.

Red water generally can be controlled quite well by raising the pH of the water being treated to a value where it is close to or slightly over the calcium carbonate equilibrium point. Use of one of the polyphosphates is generally also successful; and because of the ease of application, many corrosive water sources are treated with these compounds. These chemicals may be used with and without pH correction down to a value of about 6.0. For pH correction, lime is the most economical and best alkali; soda ash and caustic soda can also be used. Liquid caustic soda [50 percent Na(OH)] is now quite generally available in drums and in tank truck lots, and in this form deserves more consideration in pH correction problems than it has received.

The foregoing statements could have been taken from a number of books and papers. But experience indicates that the solution to red water problems is not always as simple as such brief statements would lead one to believe.

Red Water Following Change in Water Character

In the authors' experience, they have run into several cases where red water conditions followed installation of an iron removal plant. In one case, where the iron-bearing water had been used for quite a long period, the red water condition lasted for a long time but finally cleared up. In a more recent experience, red water complaints were received from a system following introduction of iron removal, even though the raw well water had been

Ed. Note: This paper was presented at the Pennsylvania Water Works Operators Assn.; State College, Pa., and is published here by permission.

TABLE 1
Iron Pickup in System, 1956[1]

Location	Date	Alk., ppm	pH	Fe, ppm
Station Effl.	(Avg.)	150	8.1	0.05
Tap A[2]	9/2	130	7.2	1.00
	9/7	110	7.4	0.80
	9/13	152	7.6	0.80
	9/21	140	7.4	0.80
	9/29	146	7.3	0.45
	10/13	146	7.7	0.40
Tap B[3]	9/21	144	7.5	1.00
	9/29	140	7.3	2.00
	10/13	140	7.5	1.40

[1] Following installation of an iron removal plant.
[2] Approximately ¼ mi from station.
[3] Approximately ¾ mi from station.

TABLE 2
Turbidity and Lime in Filtered Water from Clear Well

Sample	Lime Added, ppm	Turbidity, ppm	pH
1	0	0	6.5
2	2.0	1.90	7.5
3	1.25	2.00	8.2+
4	1.25	5—10	8.2+

TABLE 3
Effect of pH on Iron Pickup in System, 1957

Location	Date	pH	Fe, ppm
Tap A	7/30	6.7	0.70
	8/5	7.9	0.30
Tap B	7/30	6.8	0.30
	8/5	8.1	0.10
Tap C	7/30	6.8	2.50
	8/5	7.9	0.50
Plant	7/30	7.1	0
	8/5	7.9	0

used (without iron removal) for only a few months. Table 1 shows analytical results from two distribution taps, the first approximately ¼ mile from the iron removal plant and the second ¾ mile away.

The pH values for these samples are generally above the staining curve of Baylis*; yet the water caused considerable trouble. This was attributed mainly to the low iron content water being in contact with old iron rust deposits. Part of the trouble was also caused by difficulty in obtaining uniform treatment with the equipment at hand. Dry feed of hydrated lime was first used, followed later by soda ash. A change to liquid caustic soda and the use of Calgon for about six months corrected this trouble.

pH and Red Water

The influence of pH on the prevention of red water is well understood and need not be gone into again here. The curves set up by Baylis are found to be a good guide for helping establish the pH to carry. In Alexandria, Va., for example, complaints concerning red water start whenever the pH of the water sent to the system falls below 7.6. These complaints came from the oldest section of the distribution system, where the cast-iron mains are not cement-lined and where some of the lines are 100 or more years old.

This plant has difficulty at times in getting sufficient lime into the treated filtered water to arrive at the desired pH without adding enough turbidity to make it objectionable. When this occurs, adding sufficient hydrated lime to get a pH of 8.0 causes the water to have a distinctly whitish, cloudy appearance—a water that could well be called "white" water. This is not due to the precipitation of free alum, but seems to be caused by slow solution of the lime or settling out of lime particles before going into solution. Table 2 illustrates what happens.

* Cox, Charles R., "Water Purification for the Practical Man." P. 70.

Both soda ash and caustic soda have been used while this lime problem is being investigated. In this period an opportunity existed to determine the effect of pH on the amount of iron pickup (Table 3) in the section of the Alexandria system previously mentioned.

Control with Polyphosphates

The use of polyphosphates for red water control has grown tremendously, and for good reason. These chemicals are easily applied and are effective at lower pH values than control with pH correction alone. This has been found to be of value in many cases, particularly in well supplies where the stations are automatically operated without attendants.

Water from the Raritan stratum in southern New Jersey quite often has a high carbon dioxide content and a corresponding low pH. In such supplies the polyphosphate feeding devices can easily be made to start and stop with the pumps, thereby reducing servicing of the station to one visit a day. Some of the Raritan stratum wells have pH values as low as 5.0, and in such locations liquid caustic soda plus phosphate treatment can be used.

In one plant such treatment has proven very effective. The pH is raised from approximately 5.3 to around 6.0 with liquid caustic soda to prevent copper solution, then sufficient Calgon is used to prevent red water. At this particular plant 4 ppm of Calgon is used, but some of this is used to sequester manganese—normally a dose of 1 to 2 ppm would be sufficient to prevent red water. Tables 4 and 5 illustrate how this treatment, which results in very little pickup of iron in the distribution system, works out.

Effects of Heavy Flushing

Many red water troubles are aggravated by excessive flushing. The usual procedure when a consumer complaint of red water is received at the water company office, is to send someone out to the affected area to flush out the offending water. This pacifies the customer who made the complaint because she sees activity resulting from her call; and usually, for the time being, this procedure clears up the water in that immediate area. However, this heavy flushing, done with the idea of tearing loose the deposits on the main often defeats its own purpose and prolongs and even aggravates the trouble.

This is true because for corrosion to proceed the water must come into contact with metal. The first step in corrosion is solution of iron from the metal surface. If oxygen is present in the water (and it is in practically every supply) this is followed by an oxidation step, which changes the iron in solution to insoluble ferric compounds. These tend to adhere to the metal and partially seal off the surface; unfortunately, however, in most cases this healing deposit is soft and only loosely adherent. Heavy flushing sets up velocities that tend to tear off this fragile loose deposit, and with its disappearance corrosive attack on the metal begins all over again.

In one system in western Pennsylvania, a 4-inch unlined cast-iron main 800 feet long was cleaned with a mechanical scraper to improve pressures and fire flows. The water supplied to this section came from an impounded reservoir source having a pH of 6.7 alkalinity of 12 to 16 ppm, total hardness of 26 ppm, and total solids of 85 ppm. Most of the remainder of this system consisted of cement pipe.

TABLE 4
Analysis of Well Water

Turbidity, ppm	0.40
Alkalinity, ppm	28
Total hardness	41
pH	5.3
Free CO_2, ppm	78
Iron (Fe), ppm	0.20—0.30

TABLE 5
Iron Pickup, Well Water Treated with NaOH and Calgon

Location	pH	CO_2, ppm	Alk., ppm	Fe, ppm	Increase in Fe, ppm
Plant	6.6	76	98	0.20	.....
A	6.4	88	90	0.20	0
B	6.3	98	78	0.18	—0.02
C	6.3	80	46	0.15	—0.05
D	6.3	90	40	0.10	—0.10
E	6.4	88	72	0.30	+0.10
F	6.4	98	70	0.15	—0.05
G	6.7	70	90	0.30	+0.10

TABLE 6
Analysis of Black Water, in PPM

Plant Location	C	Fe and Al Oxides	Al	Mn	SiO_2	Fe
Indiana	...[1]	302	132	1.00	...[1]	36
Connecticut	24	126	54	30	34	16

[1] Analyst's note: "Sludge of this sample is a mixture of free carbon, silica and hydroxides of iron and aluminum."

A soft water such as this would be expected to be quite corrosive.

Immediately after the cleaning operation, rusty water complaints began coming in in numbers from angry consumers. In attempting to clear up this condition, the cleaned line was repeatedly flushed hard, but this did not help. The situation became so bad that the water company, in desperation, was prepared to spend approximately $5,000 on a replacement line of cement-asbestos pipe. Fortunately, before this replacement work was begun, a suggestion was made that the method of flushing be changed to a procedure whereby the flushing hydrant was opened just enough and only long enough to gently change the water in the cleaned line. This was done early each morning to displace the water that had stood overnight in the line, and after about 10 days red water complaints ceased. The gentle flushing allowed the line to heal and become coated.

Conclusions on Red Water

Generalizing, experience with numerous red water difficulties leads to these conclusions:

1. The first step in investigating red water difficulties is to determine if the iron comes from the source or is picked up as the water passes through the distribution system.
2. Iron above 0.30 to 0.50 ppm in the source requires removal or sequestration.
3. In red water caused by corrosion within the system, bring the pH above the Baylis staining curve or slightly above the calcium carbonate saturation point; or
4. Use polyphosphate treatment with or without pH correction, depending on the pH of the raw water.
5. Be watchful for appearance of red water when a change in source of supply is made.
6. In flushing to clear out rusty water in an area from which complaints are being received, open hydrants only enough to gently change the water in the line. Let flow until water is clear and repeat rather frequently.
7. To prevent staining of clothes, advise consumers in effected area not to use chlorine bleach solutions, and suggest sending stained clothes to a commercial laundry for removal of stains. If home removal of stains is required, use ½ ounce of oxalic acid in 1 gallon of water, allow clothes to soak for 15 minutes, and rinse thoroughly in cold water.
8. Use cement-lined mains (where cast-iron or steel mains are desired).

Black Water

In recent years, there often have been "black" water complaints. These complaints were often from only one house in an area (usually the mayor's or a councilman's home, of course) and not always from the same house when the condition occurred again. The blackness is usually in the form of small, floc-like particles, light, somewhat greasy looking, and some of the material is finely enough divided to make the water brownish in appearance—or to appear stained brown. Clothes washed in such water come out with dark brownish to black stains or discoloration (which is aggravated by chlorine bleach solutions).

At first it was suspected that this condition was caused by carbon particles passing through filters, but closer examination has practically never shown much carbon in the distribution system. The real culprit is usually manganese, and it is apparent that this element is much more common and much more troublesome than suspected. Manganese may enter water supplies through acid mine wastes, through solution of manganese-bearing minerals (in wells), and through similar solution and organic decomposition in the bottom of reservoirs. Present in the manganous form, it is usually removed by oxidizing it to the manganic state; but this is much more difficult to accomplish than with iron. Oxidation of manganese is a very slow reaction at low pH values and the rate increases as the pH is raised. Any water with a manganese content of more than 0.05 to 0.10 ppm going into a system for several weeks will cause trouble with black water, and finally in deposits that increase friction losses.

TABLE 7
Showing Water Usage During Time of Black Water

Week Ending	Average Day, mg	Maximum Day, mg
July 6	12.38	14.11
July 13	14.01	15.90
July 20	13.70	15.92[1]
July 27	16.07	17.75[1]
August 3	12.47	13.90

[1] Complaints received.

Black water also has been found to be due to two other conditions: (a) any condition that allows free alum to pass into the system, and (b) a combination of free alum and silica from sodium silicofluoride.

In early 1956 at Davenport, Iowa, repairs being made on settling basins made it necessary to coagulate and settle the water being processed in roughly one-half the normal time. Low temperatures and exceedingly clear water at the same time made coagulation very difficult, and for several weeks free alum concentrations of between 0.50 and over 2.0 ppm (as Al—roughly equal to 6 and 25 ppm of filter alum) were present in the filter plant effluent. Hundreds of complaints were received on certain days when higher than normal water demands were made on the system. This water contained floc particles very much discolored with debris from the mains. Activated silica and extremely high optimum alum dosages, which resulted in lowered free alum, corrected this trouble.

At an Indiana plant a similar experience was found to be caused by free alum, silica, and some carbon. The appearance of the water samples in affected areas was very misleading because the suspended matter was black and looked very much like carbon. The analysis of this deposit is given in Table 6.

It was reasoned that the free alum was probably not sufficiently high to cause this trouble, but that the finely divided silica present in excess in the sodium silicofluoride added to the clear well provided a nucleus for the floc to form upon, and the floc then picked up material from the pipelines through which it passed. Good success was obtained in remedying this by changing the treatment to eliminate free alum and then changing the application point of the sodium silicofluoride to a point ahead of the filters.

In a fair number of plants black water has been caused by manganese. Manganese-caused black water is characterized by isolated occurrences

of the trouble; that is, several houses today of the 20 on a street, then others on the same street tomorrow. The disturbances occur when velocities of flow are above normal, as when peak loads are being met, when hydrants are flushed, or when the fire department decides it is time to practice fire fighting. Street flushing crews that open and close hydrants too quickly can also be the cause of such trouble. The only good solution of the problem of manganese-caused black water is almost complete elimination of the manganese at the treatment plant. One system has trouble if the manganese gets above about 0.05 ppm, probably because this system's transmission lines are very long (13 miles) and are all new, and are of concrete or of cement-lined metal or of cement-asbestos material. This tends to raise the pH and provide time for oxidation of any manganese that slips by the plant.

Another New England company struggled with a black water epidemic when the summer load appeared and the distribution system endured considerably higher than normal flow velocities and even reversals of flow, as shown in Table 7.

Blue Water

The term "blue" water refers to the blue stains caused by copper-bearing waters rather than to the color of the water itself. Possibly this use can be excused, because again it is desired to point out that copper corrosion is probably more prevalent than supposed.

In the southern New Jersey well supplies mentioned earlier, many cause copper stains in wash basins and bathtubs. These stains are usually found around the outlet drain; it is suspected that they are caused by the precipitation of copper compounds by alkali extracted from the porcelain.

TABLE 8
Copper Content of Tap Water from Several N. J. Supplies

Supply	pH (1)	pH (2)	Alk., ppm (1)	Alk., ppm (2)	Cu, ppm (1)	Cu, ppm (2)	Stains
A	6.4	6.7	22	22	0.4	0.5	No
A	6.7	6.8	23	17	1.5	0.2	Yes
B	8.4	8.4	77	79	0.08	0.05	No
C	7.3	7.3	53	51	tr	tr	No
D	6.3	6.3	45	41	0.9	0.4	Yes
E	6.3	6.3	16	12	2.0	0.95	Yes
F	6.2	6.1	22	16	2.5	0.2	Yes
G	6.0	6.2	45	42	0.5	0.3	?

Because the authors' company has been faced with several problems of treatment of such waters to eliminate these staining tendencies, which involve application of chemicals and economy in unattended automatic stations, it was necessary to know the pH needed to prevent excessive copper pick up. In the course of this investigation it was somewhat amazing to find the high content of copper that exists at times in household piping and causes no harm (see Table 8).

Tentatively, investigations show that a water with a pH of 7.0 or over will not cause staining of bathroom fixtures. It was thought that polyphosphates will not protect copper as they will iron, but there is some indication of help through the use of these compounds. Calgon alone will not prevent excessive copper pickup at a pH of 5.0 to 5.3.

One interesting case of copper corrosion trouble in the area served by supply F (Table 8) occurred in one side of a double house. The copper content of the water in this side of the premises has been so high so consistently that when vegetables are to be cooked water from the adjoining household must be obtained. This trouble began when all of the household piping was converted to copper pipe—the other side of the house still has a galvanized service line. Removing the power line and telephone grounds, installing a new service and an insulating coupling have not corrected this trouble.

In conclusion these suggestions (in addition to those made about the prevention of red water) are offered:

1. On black water control:
   (a) Reduce manganese to at least 0.10 ppm, and to almost 0 if possible;
   (b) Control the coagulation process so that free aluminum will be less than 0.30 ppm Al in the filter plant effluent; and
   (c) If sodium silicofluoride is being used, consider applying this chemical to the raw or settled water, ahead of the filters.
2. On blue water control:
   (a) Raise the pH to 7.0 or higher.

Knowledge Is the Key to an Adequate Water System

According to the water resources experts at Battele Memorial Institute, a lack of knowledge of the local water situation can cause a community to lose a prospective plant just as quickly as a lack of water itself.

Writing in a recent issue of the Battele Technical Review, Thomas D. Best and Robert C. Smith, attempt to place water problems in their proper perspective.

Water problems are local problems, each locality must work out its own specifics to solve water resources problems. The abundance or shortage of water now or later in any specific locality is certainly an important factor in its development, the Battele writers concede. But many other factors of equal importance must be taking into consideration, if a development group is to intelligently plan the use of local water resources. "Realistic appraisals of the industrial water picture need seldom discourage sincere, objective area development groups," says the writer. "Few regional or state groups would be unable to attract some kind of industries somewhere within their territories if they have other assets attractive to industrial development."

The article also discusses technological advances in industrial processes that can be employed to either make greater use of available water or to actually make industrial production possible with appreciably less water.

Apart from the amount of water available in a given locality, the authors say that many other aspects of the water situation should be considered by area development planners. These include the quality of the water, waste product disposal, and even the community's attitude toward its water problem.

> Tolerance is sometimes only a suspicion that the other fellow may be right.

Handy nomograph provides an easy, rapid method for calculating . . .

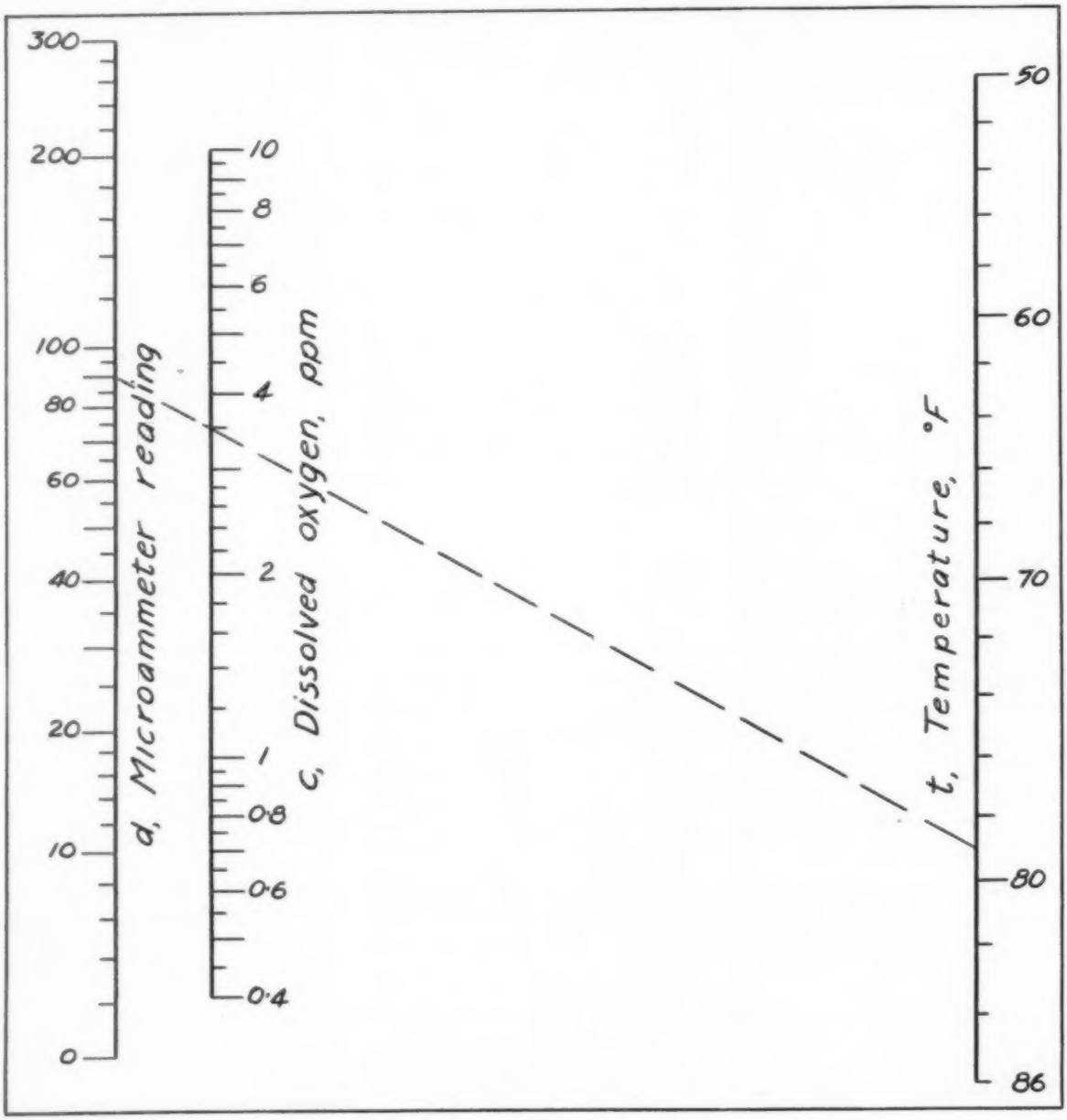
Pressure Losses in Water Meters

Mathews,[1] in the AWWA Journal, presented data on the pressure drops through water meters at various rates of flow. This logarithm of pressure drop in linear with the rate of flow was used in the construction of the accompanying line coordinate chart. The chart was constructed by well-known and standardized methods.[2]

An example of how the chart works is illustrated by the following: **Q.** What pressure drop may be expected in a 1½ in. water meter when the rate of flow of water is 70 gal/min? A. Connect 70 on the rate scale and 1½ on the meter size scale with a straight line. The extension of this line, upon meeting the pressure drop scale shows the loss to be 12 lb/sq in.

By D. S. DAVIS
Head, Dept. Pulp and Paper Technology
University of Alabama
Tuscaloosa, Ala.

References:
1. Mathews, C. M., Journal, American Water Works Assn., 49 (9) 1911 (1957).
2. Davis, D. S., "Nomography and Empirical Equations," Chap. 10, Reinhold Publishing Corp., New York, N. Y., 1955.



Special control and development problems point up the inherent difference between . . .

Water *and other natural resources*

By EARNEST BOYCE,
Chairman, Dept. of Civil Engineering,
Univ. of Michigan, Ann Arbor, Michigan

EDITOR'S NOTE: In this paper,* the author details in a non-technical manner, a few of the many special problems that must be considered in the effective utilization of our water resources. He points out particularly that an extension of the principles of law are needed to establish the orderly procedures necessary for the most efficient development of this resource.

■ A STUDY OF the principles and philosophy of the laws that now govern the actions of society in dealing with our water resources, has at long last, been started.

As the need for water utilization develops to the point of competitive demand, our best interests will be served by the further evaluation of the functions that this resource must perform and an extension of the principles of law that will establish the orderly procedures necessary for the highest development of this resource, consistent with society's economic needs.

When we tabulate the natural resources that man, with science-directed skill, has utilized to build the foundations of the economy that we know, we may classify these resources in many ways—all of them except water.

As a resource, water is a requirement so basic to man's existence that all other resources are either dependent on its plentiful supply or, in its absence, valueless for man's use and development.

Our lands, with their capacity to produce our abundant food supplies, our forest and fiber needs, and all the renewable resources of organic growth, are dependent for their productiveness on the timely availability of this resource. The conversion of our mineral resources into the useful products of our manufacturing industry cannot be accomplished without the availability of the necessary quantities of process water.

Finally, we should note that man, himself, as a living being, requires the constant availability of safe, palatable water for his physical and domestic needs. And, through a knowledge of modern sanitation, he has learned the health and comfort advantage and necessity for the water-borne removal of the wastes of human habitation and of industry.

Most Water Uses Are Not Consumptive

While many of our natural resources vanish with use, most water usages produce changes in the position, quality, and/or quantity of the water, depending on how it is used. The multiple usage of the resource, water, within one hydrological cycle, is frequently an economic necessity.

Water power energy may be recovered from a change in position of the water as it moves on its way by gravity to some lower elevation. This energy recovery may not offer serious water use competition so long as other energy sources are available, for the water remains unchanged in quantity and in quality. This is not a consumptive use of the resource.

However, many of the necessary uses of water do produce changes in either its quality or quantity. A change in quantity is usually the result of evaporation or transpiration loss, as for example, in irrigation, lawn watering, evaporative cooling, and non-condensing steam production. Water quality changes are produced when the use of the water causes it to pick up and carry, in solution or suspension, substances not previously present. The water resource significance of this change in quality is to be found in the cost of the reprocessing of the used water for subsequent re-use, or in the possible limitation of the re-use potential due to the fact that the reprocessing procedures of water purification, including sewage and industrial waste treatment, do not effect a 100 per cent removal of substances that may have been added by its usage.

Pollution Prohibits Reuse

With the increased demands for the use of water in the many manufacturing and industrial processes, a new form of what might be regarded, for lack of a better classification, as a consumptive use of water, is emerging. When an industrial process so changes the quality of water as to make it unfit or unsuitable for further re-use, and when known water treatment processes, short of evaporation, are unable to remove the effect of its prior use, not only is that volume of water effectively consumed as regards its potential re-use, but, unless confined in permanent storage, it has the capacity to deteriorate the quality of the diluting water into which this indus-

* Presented at the Conference on Water Resources and the Law, held at the University of Michigan Law School, Ann Arbor, Mich.

trially used water is discharged. The process water used in the preparation of our atomic fuels is one example of this type of water usage and there are many others.

Constant Availability Unpredictable

However, it is not so much the varied ways that water may be used that set it apart from other natural resources. Rather, it is the unpredictable variations in the quantity available from rain or snowfall in any period of time and in any locality. While no natural resource has been more amenable to man's control than water, no resource has so baffled him with its cyclic variations of flood and drought. As usage demands approach or pass the available water supply in periods of drought, a shocked public concludes that the water resources are failing and that something must be done about it. Then, suddenly, the picture changes and floods replace the shortages and public interest ebbs.

Because the usage demand of industry and the domestic water supply of industrial areas continue with some degree of uniformity through seasons of drought, it follows that this demand must be supplied from some form of natural or constructed storage, or a combination of the two, so that waste flood waters can be controlled to equalize the source of supply.

Because of the ever increasing demands for water to supply the needs of an expanding economy, well planned expansions of suitable and economical water control measures are becoming increasingly important.

In certain of the arid sections of the United States, where the availability of water controls land use, water control development has approached an economic limit that is fixed by the increasing cost of storage over a lengthening period of time as more and more of the waters of the less frequently occurring floods are impounded for use.

While the situation in the more humid regions of the United States is, in general, less critical, a failure on the part of those who plan the expansion of certain industries, with heavy water use demands, to recognize the economic significance of the cost of water supply development to meet these demands, may easily create serious local supply problems.

Increasing Usage Creates Legal Problems

The present interest in the legal aspects of water use and control stems, in part, from an awakening realization that the once ample water resources of the eastern states are in certain areas no longer adequate, without further development, to meet the maximum use demands being placed upon them. In many instances, a regulation of flow through the construction of storage facilities may be indicated. In other situations, heavy water control expenditures might be avoided if some legal restriction were to be imposed on the development of certain land areas for usages that will require unusual volumes of water. In other words, many of our water shortage problems in this section of the United States are man-produced in that too often there has been a tacit assumption that the existing water resources were adequate for any land development need.

The availability of water for use or development and the possibility of discharging used water, without damage to others who may be dependent on the receiving body of water as a supply source, and at a cost that can be borne by the development creating the demand, should be established as a basic criteria to be met by all who plan changes in land use.

More Basic Hydrological Data Needed

Unfortunately, the basic hydrological data needed for a reasonable evaluation of the water resources of many important river basins are too inadequate to provide a sound basis for planning the developments needed to meet future requirements.

The Commission on the Organization of the Executive Branch of Government, known as the Hoover Committee, as the result of its study of water as a natural resource, noted that "It is self evident that if a water resource project is to yield maximum benefits at the lowest possible costs, its planning and construction must be based on adequate and reliable data concerning all social, economic, and physical aspects of the project." The report goes on to state that "The really disturbing thing is that so little progress has been made in obtaining reliable hydrologic data in advance of project planning and construction. Though the necessity for more adequate data has long been recognized, we find ourselves embarking on the most gigantic water projects ever devised, with alarming gaps in our knowledge of the probable behavior of the waters we are trying to control and utilize. So serious are these deficiencies that it is estimated, on the basis of experience, that the limit of error or ignorance in present water developments is rarely less than 25 per cent and is frequently greater than that.

"Present knowledge of the relationships among precipitation, runoff, evaporation, ground water movement, soil condition, vegetal cover, transpiration, etc., is far from complete, but our greatest shortcoming has been the failure to provide sufficient funds for the utilization of rain gages, snow surveys, stream flow measurements, evaporation stations, runoff and erosion studies, ground water observation wells, water quality analysis, and other established methods of obtaining data essential to the planning and construction of river development projects.

"Continuous application of these techniques over a period of years is required to furnish reliable data, yet not infrequently, the first intensive efforts to apply them are coincidental with the commencement of a project study. Few areas are even adequately mapped for water development purposes."

Unless these basic data are obtained in advance of development, there can be no sound basis for the allocation of the water resources. The collection of scientific data has little popular appeal and many state budgets fail, as the Hoover Report indicates, to make reasonable provision for obtaining data that must be collected over a period of years to have design value. The proper development of water resources, both from the standpoint of increasing the quantity available during periods of drought and the control of flood damage, is a matter of real public concern. It is important, therefore, that conferences should give consideration to legislation that will insure the establishment and financial support of these necessary and permanently continuous fact-finding agencies of the state and federal governments. We must know the measurements of the resource before we can hope to allocate its use with wisdom and judgment.

If water use allocation were to be limited to the quantity available from the normal uncontrolled flow of surface water and from ground water pumpage in a river basin, it is obvious that the limit of allottable usage would be that available during the minimum flow period modified by ground water storages, and, therefore, much of the potential water resource of the basin would be lost. It follows that the allocation of water usage in amounts in excess of this minimum uncontrolled discharge would require that there be an analysis of upstream flow regulation including a determination of its engineering and economic feasibility.

Planning Should Encompass Entire Drainage Basin

The source of water as a usable resource is the rain and snow that falls on the catchment area of a river or lake basin. Consequently, the land and water area of a drainage basin forms the natural areal unit for the study of the various ways that the waters of the basin can be controlled for flood protection and for use and, in some instances, for multiple re-use.

Depending on the topography and geological formations, river basins vary widely in their capacity to naturally equalize the discharge rate of rain and snowfall. The filling and subsequent drainage of permeable formations in the river basin provide the dry weather river discharge. These formations also provide the below-ground water storage, recoverable through the use of wells. In some basins the storage capacity of the permeable formations may approach that necessary for a full control of the river discharge. In other basins the storage potential of river valley aquifers can be greatly increased through a development of recharge areas tributary to well fields.

The planned development of the water resources of any river basin requires that all these basic factors be studied as an integrated unit. While public and economic interest in the water may vary along the course of the river draining the basin, it is the same runoff water that passes each section of the valley and changes in its quantity and quality are the product of its control and use through the length of the valley.

The destructiveness of our floods is evidence that the developed land usage of the flood plains of a river is competitive with the need for the same flood plains for the passage of floods that originate up-valley.

Not only should the development of the water resources of a river basin be studied as a unit and a mutually acceptable policy of use and control be developed, but public works based on these studies may need to be basin-wide in their scope to secure the highest development of the water resources of the valley; again, consistent with society's economic needs.

Aside from flood control, much of the legislation authorizing the development and financing of public works relating to water resource development has been enacted to meet the situations that confront cities and other political subdivisions concerned with a definitely local water supply problem. Water supply has been too long regarded as a utility problem having localized interest. Consequently, each unit of local government has been compelled to operate within its limited jurisdiction to secure the water supply development that its growth requires. There appears to be a need for an operable and functional agency of government with the freedom of action necessary to coordinate the varied interests of a river basin into a unified plan.

Conclusion

In these remarks, an attempt has been made to point out some of the special problems of water control and development that make this resource inherently different from others and to indicate a few of the legal aspects of these special problems.

This is not a new field of research and investigation and many excellent studies have been made by the agencies of the several states and by the federal government.

It is hoped that as the result of this conference, some new thought can be brought to bear on this important subject, some concept of how to integrate what we know about water resource development into a workable and legally acceptable way of acquiring, under the democratic procedures of government, the benefits that can be had.

Bibliography:

Books:

The Report of the President's Water Resource Policy Committee, 1950.
Vol. I. "A Water Policy for the American People."
Vol. II. "Ten Rivers in America's Future."
Vol. III. "Water Resource Law."

"Principles of a Sound National Water Policy," The National Water Policy Panel, Engineers Joint Council, July, 1951.

"Natural Resources, Appendix L.", prepared for the Commission on Organization of the Executive Branch of Government (The Hoover Report), January, 1949.

"Physics of the Earth—Hydrology," by Meinzer, 1942.

"Aspects of River Pollution," Academic Press, Inc., London, 1957.

"The Conservation of Ground Water," by Harold E. Thomas, 1951.

"The Dark Missouri," by Henry C. Hart, 1957.

"Man and the Waters of the Upper Ohio Basin," Special Publication No. 1, Pymatuning Laboratory of Field Biology.

Text books on Hydrology; publications of the U. S. Army Engineers, U. S. Public Health Service, the Bureau of Reclamation, and Reports of the Ohio River Valley Water Sanitation Commission.

Articles:

"Principles of a Sound Water Resource Policy," American Water Works Association, 1957.

"Water Appropriation in Kansas," K.E.S. Bulletin, June, 1957.

"The Texas Water Story—Lessons for All," Engineering News Record, July 11, 1957.

Sewage in Anglo-Norman Castles*

In the great Anglo-Norman castles of the 12th and 13th centuries sewage for the mighty knights and their attendants was provided by unique garderobes, or privies, formed in the thick stone walls like niches. There was a holed seat of stone with a battered off fall for the excreta up the centre of the wall, sloping to the outside of the fortress.

In the King's castle, Ardglass, Co., Down, there was a water-carriage system of sewage leading to the sea about 200 yards away. This consisted of a sewer built in the form of the letter "A", and flushed by the running water from a land stream. The idea of the "A" shape was used because in the hydraulic calculations of the builders, then contended that the water was confined to the floor of the sewer under the inverted wedge pressure, thus sweeping it clean. The floor or invert was made of flat stones of a hard formation and still exist in places, quite sound until this day.

* Submitted by C. J. Robb, Ballynahinch, Ireland.

Meeting in Dallas brings Texas-size registration to the . . .

AWWA 78th Convention

■ FOR THE FIRST TIME in its history, the American Water Works Assn. held a meeting in Dallas, Texas. It was a huge success. From the annual supper, the Big D Buffet, on Sunday night, April 20, to the dying strains of the last waltz at the annual dance on Thursday evening, April 24, there were four days crowded with technical meetings, entertainment and socializing.

Entertainment and Awards

On Monday evening, April 21, the annual awards session was held followed by the reception for the officers and a dance in the Crystal Ballroom of the Baker Hotel. The Association Awards for the year were published in the April issue of *Water & Sewage Works*, except for the Fuller Awardees, who were:

THESE three secretaries of the Association bore the brunt of handling registration, scheduling sessions, and handling committee meetings, etc. They are, from left to right, Harry E. Jordan, Secretary; Raymond J. Faust, Exec. Asst. Secy., and Eric F. Johnson, Asst. Secy. for Publications and Editor of the AWWA Journal. They were assisted by Mary E. Rodgers and Lois Jordan Schulz from the AWWA office staff.

The new Directors of the Association are:

Robert H. Hess	Kansas
John R. Purser, Jr.	North Carolina
M. K. Tenny	Iowa
William B. Schworn	Missouri
W. B. Harman	Virginia
Dennis H. Clark	West Virginia
J. Orville Jones	Rocky Mountain
O. J. Muegge	Wisconsin
J. A. Frank	W&SWMA
John L. Ford	Indiana
W. Franklin Richards	Intermountain
Carl C. Lanford	Southeastern
W. H. Gilmore	Ala.-Miss.
Q. M. Mees	Arizona

Technical Program

Fifteen technical sessions were held with more than 57 topics presented and discussed by more than 100 persons. The report on these sessions will appear in the next two issues.

H. Reinhardt	Calif.
G. H. Strickland	Canada
A. G. Fiedler	Chesapeake
S. W. Wells	Florida
D. W. Johnson	Illinois
J. Gordon	Indiana
P. J. Houser	Iowa
P. D. Haney	Kansas
C. H. Bagwell	Ken.-Tenn.
H. H. Caswell	Michigan
G. H. Dyer	Missouri
C. H. Brinck	Montana
J. H. Kruse	Nebraska
J. C. Knok	New Eng.
W. J. Orchard	New Jersey
L. B. Smith	New York
E. C. Hubbard	No. Car.
G. J. Schroepfer	No. Central
R. H. Fuller	Ohio
W. F. Rockwell	Penna.
L. R. Simonton	S.E. Sect.
G. H. West	SW. *Sect.*
H N. Lowe, Jr.	Virginia
T. J. Blair	W. Va.
M. S. Nichols	Wisconsin

Tuesday night was Texas Night—a variety show held at the Lyceum Theater. Two luncheons, not on previous programs included the Southwest Section Luncheon on Monday, April 21, and the State Sanitary Engineers' Luncheon on Tuesday, April 22. The Fuller Award Society met for its annual breakfast on Wednesday. Wednesday night was open for individual entertainment and dining, and Thursday night saw the installation of the new officers at the Annual Banquet, which was followed by a dance at the Statler-Hilton Hotel.

The ladies had a tea in the Peacock Room of the Baker Hotel on Monday afternoon; a Blue Bonnet Luncheon and Fashion Show by famed Nieman-Marcus on Tuesday and a "Big Deal" Card Party in the Ladies Rendezvous at the Auditorium on Wednesday.

WSWMA

Almost 100 members of the WSWWA had exhibits at the Auditorium, a list of the exhibitors was published in our April issue. At the annual luncheon, members and guests of the Manufacturers Assn. were privileged to hear an address by **Frank Rockwell Burnett**, Research Director of the Richardson Foundation. Mr. Barnett, who was a featured speaker at the recent New York meeting of the National Assn. of Manufacturers, is a specialist in foreign relations, especially those having to do with the Soviet Union. Mr. Barnett is a former Rhodes Scholar, who saw military service in World War II as a Russian interpreter with the 69th Division; he later became a Professor at Wabash College in Indiana.

Following the luncheon a business meeting was held at which officers were elected to take office next January 1. The list of these officers will appear in the next issue.

Water works practices as observed in the United States adopted by Germany for the . . .

Chlorination *of drinking water*

By DR. KARL IMHOFF
Consulting Engineer, Essen, Germany

EDITOR'S NOTE: In this article, translated by C. E. Keefer, Editorial Associate, Ass't. Bureau Engineer, Bureau of Sewers, Baltimore, Md., Dr. Imhoff relates his personal experiences in applying American techniques for the chlorination of water, to German water works.

■ WHEN I was in America for the first time in 1909, almost 50 years ago, I was astonished that the water in the bathroom smelled of chlorine. During the inspection of waterworks I saw chlorine apparatus, as for example at the Boonton waterworks in Jersey City. In the office of the consulting engineers, Hering and Fuller, in New York, I became acquainted with the engineer, George A. Johnson, who had built the first chlorinating plant for drinking water in 1908 for the stockyards at Bubbly Creek in Chicago. The process had an enormous success throughout the whole country. Within scarely a year, already 100 waterworks plants, which had arranged for the use of chlorine, were known.

I consider Johnson the inventor of the process. Others may have proposed it previously or have also tried it in the laboratory, but it was Johnson who introduced it in practice in its true form. The essential thing about the chlorinating of drinking water is that one uses it only when the water is physically clean. Then the only purpose of the chlorine is to decrease the number of bacteria and so to destroy the possible cause of sickness to practical suitable limits. A second important American rule is that one of course adds as little chlorine as possible, but still enough so that a small excess persists up to the water bibcock. A waterworks that thus makes use of chlorine is according to experience completely insured against sickness being spread through water. The quantity of chlorine added to water was extremely small, less than 1 in 1,000,000. The cost was ridiculously low at about 1 cent per 22,000 gal. of water.

The chlorination of drinking water in America made a great impression on me. I said that that must be the proper thing for the Ruhr waterworks.

Ruhr Waterworks

At these works the river water was filtered through the natural gravel in the Ruhr valley. The treatment was at first unreliable so long as the river water could penetrate only through the river bottom and at places along the banks into the gravel. The river bottom became easily covered with mud and then no longer permitted the entry of sufficient water into the gravel. Then severe operating difficulties could occur as in 1901, the year of the typhus epidemic in Gelsenkirchen. First, A. König, the meritorious chief engineer of the Gelsenkirchen waterworks, introduced the final modern building principles of the Ruhr waterworks by means of his filter basins. The river water now enters independent of the real river-course through the filter basin into the Ruhr gravel. The basins are covered with a layer of sand, which is cleaned regularly as with slow sand filter technique, approved for a decade.

Our Ruhr waterworks, which was improved by König, from that time continually produced water in a sufficient quantity and of the best quality. Only in unusually exceptional cases during very high water or during an unusually long draught can the number of bacteria exceed the usual limit. In such cases, a simple disinfection procedure at that time failed. It seemed to me that the Americans had found the correct procedure. Together with the young American, Charles Saville, who worked for a year in Essen to continue his education, I assembled all the attainable supporting data relative to the new procedure in an article: "The Disinfection of Drinking Water in North America with Chloride of Lime."

In opposition to this article a caustic challenge appeared in the same magazine on April 22, 1911, by Dr. Pflücker with the following concluding sentences:

> "If one includes every thing, it results that such a treatment as is being used in America is quite unsuitable to free water from harmful bacteria (and only this is of importance) so that it becomes serviceable for useful purposes. This is by the use of large quantities of chlorine not yet the case; likewise the removal of the excess chlorine from the water must be effected."

The stern facts passed lightly over the scientific rejection of the treatment. Professor H. Bruns, the meritorious hygienist of the Ruhr district,

and I made extensive experiments with the American treatment at a pumping station at the Gelsenkirchen waterworks. The experiments confirmed the America statements. Then came the excessively dry summer of 1911, which reduced the flow of water in the lower Ruhr to an unprecedented extent. The number of bacteria increased threateningly. As a single stop-gap, which could immediately be effectively prepared with the least effort, Bruns arranged for chlorination at the large waterworks.

The result was conclusive. The drinking water at all the works remained tolerably pure, although at times the purification plants of the Ruhr district, so important today, still failed; for the district at that time was not yet established. Professor Gärtner, the noted hygienist of Jena, had later reduced the repressed typhus epidemic at Mülheim in the summer of 1911 by the treatment of the drinking water with chloride of lime.

At all events the Ruhr waterworks have been provided with chlorinating apparatus since that time. Many other German waterworks later adopted the treatment, particularly when chlorine gas could be procured after the first world war in steel containers.

Among some European experts there is still found the dislike, based on principle, for chlorine as in 1911 in the time of Pflücker. Waterworks, which have genuine spring or ground water proudly avoid using it, but works also referred to more or less as surface water plants made use of their chlorine apparatus only when it was really necessary, when the number of bacteria as judged by the count amounted to over 100. That situation was changed first in 1945 under the jurisdiction of the garrison authorities, who wished to have absolute assurance against water-borne sickness. Continuous chlorination was ordered as is usual in the United States.

The aversion to the publicity to chlorinating drinking water can, therefore, be understood, because chlorinated water often tastes bad, namely in coffee or tea. But that is not attributable to chlorine alone. Even an excess of chlorine and even a little odor of chlorine at the water spigot is harmless, for it disappears upon boiling. Especially have no injurious results made their appearance during the long years of operating experience because of an excess of chlorine.

The taste of chlorophenol can be disgusting. This taste originates when the smallest traces of phenol (carbonic acid) from industrial operations are present in the original river water. This difficulty often appeared in recent years in the Ruhr district and likewise in the cities on the lower Rhine. These inconveniences could be prevented when the phenol is held back in industrial operations or when it is destroyed by biological water purification. When phenol gets into the municipal waterworks and has formed chlorophenol when acted upon by chlorine, it can be made innocuous by activated carbon. The Ruhr district had already demonstrated that in 1928 in the practical operation of the Hamm waterworks.[2]

Recently ozone is also used to improve the taste. For the single household there is also available a small filter.

The chlorinating of drinking water, which had already been made during my first journey through America in 1909 so great an impression, has accordingly also stood the test in Germany. It offers an unconditionally reliable surety against the spread of sickness by drinking water.

References

1. "The Disinfection of Drinking Water in North America with Chloride of Lime," by Karl Imhoff and Charles Saville, Journal für Gasbeleuchtung and Wasserversorgung, 53, Dec. 3, 1910, No. 49.
2. Improvement of Taste of Chlorinated Drinking Water by Use of Activated Charcoal Filters," by K. Imhoff and F. Sierp in Gas-und Wasserfach, May 18, 1929 and Public Works, Vol. 60, Aug., 1929.

Pre-Assembly Saves Time Installing Sewer Line Under River

Partial pre-assembly of reinforced concrete pipe sections resulted in substantial time savings during the recent construction of an 1100-foot-long interceptor sewer across the Allegheny River six miles above Pittsburgh's Point.

The 30-inch diameter sewer was laid in a trench as much as 28 feet below the surface of the river, it will carry both sewage and surface water from the Greater Pittsburgh communities of Aspinwall, Sharpsburg, Blaw-Knox, Verona and Montrose.

It connects with a trunk sewer which will run under downtown Pittsburgh on its way to the Woods Run treatment plant three miles down the Ohio River.

Because all connections in the interceptor sewer had to be made underwater by a diver, it was decided that the diver's underwater time could be substantially reduced by reducing the number of connections. This was accomplished by pre-assembling ten 96-foot pipe sections, consisting of six 16-foot sections each.

Pre-assembly of some of the king-size sections was made in the hopper barges, but others were assembled after the 16-foot sections had been transferred to deck barges. Each connection was made by bolts, which passed through lugs set in the ends of the sections. Each joint is sealed with a rubber gasket.

A derrickboat, utilizing a special 4-ton rigging which supported the 30-ton pipe section in seven wire rope slings, swung the assembled section off the barge and lowered it into the trench in the river bed.

The diver then was lowered to the bottom of the trench, where he began issuing instructions to the derrickboat crew by telephone. With the assistance of a second derrickboat, the pipe was slowly shifted until its tapered end slipped into the recessed end of the previously laid section and formed a watertight connection against the rubber gasket.

After bolting the new joint, the diver walked the length of the pipe, backing off the bolts of the pre-assembled sections to allow for settlement.

A DERRICKBOAT, with a special four-ton rig, lowers a 96-foot pre-assembled length of pipe into the Allegheny.

Active, informed, local governing bodies, plus enlightened governmental agency cooperation provide the answers to . . .

Water Supply Problems, *in Nassau County, Long Island*

W. FRED WELCH, Senior Hydraulic Engineer, Div. of Sanitation and Water Supply, Nassau County Department of Public Works, Mineola, L. I., New York, in this paper* on the Evaluation of Water Resources Investigations in Nassau County, points out the valuable assistance provided the county by the U. S. Geological Survey Water Resources Division, Ground and Surface Water Branches, in solving water supply problems brought about by the almost overnight change from farmland to urban development.

Within a comparatively short span of years Nassau, second youngest county in New York State, having an area of 275 square miles and a population of about one million three hundred thousand, has undergone a complete change of character. Almost overnight, great farmlands have been harvested into thriving communities of thousands of homes, busy shopping centers, churches, colleges, schools, public buildings and industries.

Rapid Growth Sets Record

While farmland has decreased, farm irrigation has increased to obtain better yield from remaining acreage. No county in the United States has grown so rapidly.

The population of Nassau County in 1930 was 303,053 (Federal Census), and on January 1, 1957, Long Island Lighting Company estimate was 1,146077, an increase of 843,024. In addition to its population growth, it has witnessed during this period an increase of 250 per cent in industrial plants. Fortunately, this phenomenal population growth, with its more than 300 per cent increased demand for water, has been successfully met. Light industry is now the core of economic development. Until now, housing has been the core, but the picture has changed.

County officials have become ever more familiar with the problem of keeping pace with the demand for water during a period in which the curve of population growth is moving constantly and rapidly upward, while each day brings forth some new appliance or some new technique of production to increase more and more the water requirements. There are (50) public water supply systems in the County consisting of water districts, villages and private water supply companies.

Problems of Growth

The problem of the conservation of Long Island streams, a natural resource in the form of fresh water streams, was recognized by local governing bodies on Long Island. Robert Moses, Chairman of the State Council of Parks and President of the Long Island State Park Commission, sensed their future importance in the year 1925 and something definite has been done to prevent pollution and contamination of the streams.

The Long Island State Park Commission in 1925 was able to obtain surface areas on the south shore so as, at once, to protect the streams and their boundaries and to furnish park and recreation areas along them. Additional lands bordering on these streams nearly to their source were acquired from private owners by purchase and, in some cases, by eminent domain.

The acquisition of lands and surface easements along the streams protects them as a means of insuring the purity of the water source. The County, towns and municipalities have also improved streams as by-products of storm water drainage facilities.

As the mounting wave of population increased, more and more streets were paved; homes, schools, churches and commercial and industrial buildings in great numbers were erected, and sanitary sewers and storm drains installed. The run-off of storm waters from pavements and roofs greatly increased, and instead of natural percolation into the ground, was carried away in vast quantities by storm sewers to tidewaters. The pumping levels of ground water wells were decreasing. The need, therefore, was to devise a plan, a system of drainage that would restore rainfall to the soil

* Presented at the Annual Convocation of the personnel of the New York District of the Water Resources Division, United States Geological Survey, at Albany, New York.

and maintain the ground water at stable levels.

In the year 1933, the State Legislature enacted an amendment to the Conservation Laws placing the apportionment of ground water resources of Long Island under the jurisdiction of the Water Power and Control Commission Division of the New York State Conservation Department. Since the year 1932, Nassau County has been engaged in the investigation of ground water resources, and since the year 1936 in the investigation of surface water resources in cooperation with the United States Geological Survey and the Water Power and Control Commission.

In anticipation of continued population increase, the Nassau County Board of Supervisors, with foresight and vision, authorized, in the year 1936, the development of a long range drainage plan and water conservation plan which was prepared for the then existing Nassau County Sanitation Commission (Board of Supervisors) under the author's direction.

This plan provided for the construction of artificial storm water recharge basins of one acre or more in size in areas where feasible, as a conservation measure to replenish ground water storage. Under this program, 405 recharge basins have been developed with successful performance. These recharge efforts have resulted in saving millions of gallons of storm water which otherwise would have been wasted to tidewater. Large diameter precast diffusion pipe wells with flared openings have been installed to drain small tributary areas; also in several artificial recharge basins to augment seepage.

Cooperative Survey Program

The County's cooperative activities with the United States Geological Survey over the years have accomplished much with particular reference to the following.

(1) Ground water problems involving a determination of the occurrence and quality of water in geologic formations and estimates of the productivity of wells.

(2) Salt water encroachment in potentially critical areas from Long Island Sound, the Atlantic Ocean, bays and estuaries which involve inter-relationships between ground water movement and surface waters; outpost observation wells in proximity to shore lines to determine fluctuation of static levels and chloride content.

(3) Estimates of how changes in stream flow affect ground water conditions and measurement, and systematic records of surface discharge and ground water flow and quality of water.

(4) Relative practicability of developing surface and ground water for particular needs.

(5) Investigation of ground water pollution from industrial wastes.

(6) Research work and reports on an experimental storm water recharge basin at Garden City. Rates of infiltration have been determined under different conditions; also related meteorologic, geologic and hydrologic data, including evaporation of water from a land pan and floating pan (to our knowledge the first experimental project of this kind on Long Island).

How Requests for Water Use Are Handled

Every application for new or increased use of water is investigated and reported to the Board of Supervisors. Testimony is presented and exhibits prepared by the author and his assistants on all important applications at hearings before the Water Power and Control Commission, the data for which was obtained as a result of cooperative work with the United States Geological Survey.

A noteworthy example was Water Case No. 1424 of the City of New York in its application to the Water Power and Control Commission in the year 1940 for an additional fifty (50) million gallons of water from 30 proposed wells in Nassau County. Based upon the testimony and evidence presented, the application, after 23 hearings held by the Commission, was denied, with the statement in its decision that the waters of Nassau and Suffolk Counties were to be reserved for the people of those counties.

It is a known fact that water supply knows no geographical boundaries. However, continuous cooperative work with the United States Geological Survey and the New York State Water Power and Control Commission by the Dept. has enabled the County to have factual data and reports regarding hydrologic and geologic conditions in Nassau County, and the neighboring counties.

Current efforts to conserve ground water supplies include recharge basins, storm water diffusion wells, diffusion wells for cooling and air-conditioning waters, industrial waste treatment and water re-use, and enlightened governmental agency study and control.

The solutions of the engineering aspects of the problem of water supply, sewage and pollution control, drainage and refuse disposal all lie within the fields of our professional practice. These solutions are basic as to the continued growth, health and welfare of our people.

It shold be emphasized that the cooperative survey program with the United States Geological Survey Water Resources Division, Ground and Surface Water Branches, has provided invaluable assistance to Nassau County in making an authoritative appraisal of the water supply problems for intelligent, long range planning for domestic, industrial, commercial, agricultural, air-conditioning and air-cooling requirements.

Reservoir in the Sky

The Weekly Weather and Crop Bulletin of the U. S. Weather Bureau provides a current record and review of precipitation throughout the United States.

In a recent issue (Nov. 25) they presented a map showing the average annual precipitation in millions of gallons of water per capita by the various State climatic divisions. The precipitation figures were based on the period from 1931 to 1955 and the 1950 census was the basis of the population figures. A second map showed the average annual precipitation in millions of gallons per square mile by State climatic divisions. The accompanying article states "more dams, more ponds, new under-ground storage systems will be required in the future to supply the needed water resources for the increasing population, for industralization, and for farm irrigation."

If you are not currently a subscriber to this service, you can obtain further information by writing to: Weather Bureau, U. S. Department of Commerce, Washington 25, D. C.

Indiana Water Company employs modern marketing techniques to solve a difficult problem in . . .

Customer Relations

by THOMAS W. MOSES, President,
Indianapolis Water Company

Interviews—Surveys—Opinion Sampling—Public Relations Consultant—Advertising—and their application to a private water company's problems of rate increases and absentee ownership are explained in this condensation of a talk given by Mr. Moses before the Pennsylvania Water Works Assn. at Atlantic City, N. J.

■ FOR OVER 40 years prior to 1953, the Indianapolis Water Company, through efficient, economical operation, and infrequent rate increases dictated by the general economic trend during that period, enjoyed excellent relations with its customers. However, the rapid inflationary trend that occurred just prior to, and during 1953, had taken its toll by reducing the company's rate of return to substantially below 4 per cent. This, of necessity, required direct and positive action, and in September 1953, a request for a rate increase was filed.

The petition for a rate increase, coupled with the fact that only a few months before, control of the company had passed from the Geist Estate to the Murchison Brothers of Dallas, Texas, indicated that its customer relations were headed for difficult times.

The Problem

Indianapolis is a City of less than 500,000, with slightly more than 600,000 in Marion County. The water company serves slightly more than 500,000 people. There are three newspapers in the city and the competition among them is quite keen, despite common ownership of the morning and one of the evening papers. On most issues that can be classed as "popular", all three papers frequently end up on the same side and the competition is evidenced by the degree of intensity with which they attack the opponents of the cause they champion. This does not mean that these newspapers are unfair, but they are determined and particularly resentful if they suspect that information is being withheld.

As had been suspected, literally dozens of adverse editorials and cartoons appeared in each of the papers between the filing date of the rate increase, September 1953, and the final affirmance by the Supreme Court of Indiana, January 11th, 1956. Absentee ownership was one of the main targets.

Counter-balanced against these blasts were a highly respected management. Mr. Howard S. Morse, who had been the manager and operating head of the Company from 1925 to 1949, had been brought back from retirement to become president. During this period, there was never a suggestion that management was in any way responsible, and as a matter of fact, the general comments indicated sympathy towards management, and it was intimated that they were being badly used by the rapacious Texans.

Despite this countertrend, and a certain amount of sympathy for management, it was inevitable that the reputation of the Indianapolis Water Company would suffer.

Ascertaining the Facts

In May 1955, management decided to determine just what the public's attitude toward the company was. This date was selected because of a lull in the rate proceedings, and the newspapers had been reasonably quiet.

The Market-Opinion Research Co. of Detroit was employed for this job, and their report was based on a thousand personal interviews. The probability sampling was obtained by selecting blocks using a statistical method which resulted in a cross-section of the entire area serviced by the Indianapolis Water Company. Personal interviews were made with a designated number of householders at each selected location. In order to include a representative number of men in the sample, some interviewing was done during the late afternoon and early evening hours.

Needless to say, the results of the survey showed an unfavorable attitude toward the company.

Corrective Measures

In spite of resistance interjected by the lawyers, because of the fact that the company's rate case was still before the Court, the company embarked in September, 1955, on a positive and expensive public relations advertising program.

It was decided that the excellent newspaper coverage of the company's service area would provide the best media. This, plus the fact, that institutional advertising is difficult at best, and a visual presentation was the most effective type. Local models were used and the whole campaign was keyed to the friendly service that the water company was trying to perform for the community. Television was ruled out as too expensive.

Commencing in September 1955, the campaign consisted of 7-column ads, of which approximately 60 per cent of the space was devoted to a picture and the other 40 per cent to the text of the message and a "water quiz", in which questions about the company's business were asked and answered. At the beginning of the ad-

vertising program, the 7-column ads were followed by repeats of the same ad of half-page, 5-column size the following month. All three local newspapers were used, and this program provided once-a-month frequency, with larger and more eye-catching ads appearing every two months.

Concurrent with the advertising program, an independent public relations firm was employed to study and revamp the company's communications system with the local press. After an analysis of the problems, by the firm, the company was able to become more relaxed in its dealings with the press and entertained the editorial staffs of all three papers when an appropriate occasion arose. One of the main features to come out of this new relationship was the terrific impression made upon the local newspapermen when they were shown the magnitude of the Morse Reservoir project, which was within 30 miles of most of their homes, yet not one of them had seen it before. Since that first visit, a party for the working press at Morse Reservoir has become an annual event.

As an additional step in the public relations program, 10 per cent of the company stock, held by the Murchison Brothers, was sold to local people in March 1956, and in April 1956, two local men were added to the Board of Directors.

Second Survey

In May 1956, Market-Opinion Research Co. conducted a second survey of public opinion, being extremely careful to use the same questions on a different cross-section of the service area in order to have a standard for comparison.

The results of this survey were so favorable to the company that the re-run of ads in the newspapers was cancelled and the program expanded to include radio spot announcements. The radio campaign consisted of amusing spot announcements which always ended in a bubbling sound depicting a man going under the plentiful water made available for the citizens of Indianapolis. These spots created quite a lot of favorable comment.

Third Survey

In May 1957, a third public opinion survey was conducted. One disappointing aspect of the results was the fact that while 94 people in 1955 thought the company was doing the best job of preparing for growth, only 61 thought so in 1957. It is significant, however, that all utilities suffered a corresponding decrease in favorable votes and the peculiarities of the sample undoubtedly affected this result. Finally, of the entire sample in 1957, 451 people noted the advertising, of which 90 said that they were influenced by it, and only two reported that they were unfavorably influenced. Any logical projection of this figure would suggest that 54,000 people in the water company's service area were influenced by the advertising, and of this number, almost 52,000 were favorably influenced. In Indianapolis, this is a large segment of public opinion, and it is reasonable to assume that even a higher percentage of the "thought leaders" were influenced if the non-objective standard of personal contact can be controlling.

Indianapolis Water Company
Public Opinion Surveys*

	1955	1956	1957
Feeling Toward Company:			
Favorable	798	901	935
Unfavorable	148	59	54
No Opinion	54	40	11
Rates:			
Reasonable	484	619	679
Too High	417	276	246
Service			
Excellent or Good	927	.....	959
Excellent	356	.....	450
Profits:			
Just Right	184	283	394
Too High	239	169	126
Too Low	3	11	11
Ownership:			
Municipal	388	.....	322
Private	315	.....	428
No Opinion	296	313	240

*All results based on 1000 interviews.

Conclusion

An attempt has been made here to present one approach to a problem common to all water works companies today. The brutal realism of present-day economics forces any thoughtful person to the conclusion that the private water industry is caught between the upper millstone of too low unit price and the lower millstone of inflation.

There, the private water companies must have considered understanding of its problems by the regulatory bodies. We, at the Indianapolis Water Co. feel that such understanding has its roots in keeping our customers informed of our problems and our efforts to solve them, with this educational process being carried on in a friendly atmosphere. Perhaps this is a radical departure from the traditionally frugal operations of most water companies, but the Indianapolis Water Co. feels that the financial risk was well worth the gamble.

Put my money in here, please, I can't stand to handle the filthy stuff.

A chip on the shoulder may be a positive sign of wood higher up.

An open letter to water and sewage works men, all along the line, in which it shows that . . .

Courtesy Pays Off *in many ways*

Dear Bill

Have you ever wondered why business courtesy seems to be so rare today? Take the little matter of enclosing a self-addressed stamped return envelope when writing to some one for information. How many people extend this courtesy to the man who is asked to spend time and effort on his part to obtain and supply the information? Surely, it's worth the cost of the stamp and the envelope to the requester.

Perhaps the reason for the lack of business courtesy stems from the hurry and routine of our daily lives and we let courtesy slip out of our way of doing things; courtesy is the vicitim of neglect. What should we do about the problem?

Here are Some Ideas

Not only every department head but most employees can well use a review of business courtesies from time to time—keeping handy a check list of the more important ones and referring to it from time to time to make sure we too have not "slipped" in this regard.

Here is a list of such business courtesies. They represent the little acts on our part which not only lead to more pleasant business relations but insure maximum co-operation from others with whom we must deal—our customers, people in our own departments and those in other departments.

. . . First, of course, is to use self-addressed, stamped envelopes whenever sending a request for information or data to some one else and particularly so where answering the request requires considerable effort on the part of the other person. This is most important where we are requesting something for which the other fellow will receive no direct compensation.

. . . Avoid wasting the time of individuals and firms with curiosity inquiries or requests—keep it strictly limited to business inquiries. Too often we make such requests which have little bearing on direct business.

. . . Reply promptly to all mail and act promptly on all requests of others. To say to yourself, "There's no hurry on this, it can wait," is careless discourtesy, for we can never be the judge of whether or not promptness is important insofar as the other person is concerned. It's just plain good business courtesy to grant the same promptness to others that we expect ourselves in all business matters.

. . . When the occasion arises where one cannot grant an immediate telephone or letter request one should say so frankly so that the other party can make other arrangements. It's maddening to be stalled on such matters and then ultimately be given no satisfaction whatsoever.

. . . Respect the value of another man's time. Don't ask him to do something without charge which takes up a great deal of time and effort. This is perhaps one of the most abused of all business courtesies.

. . . Be as clear and definite as you can when answering requests for information from others; an evasive reply to a request for information is of no value to anyone. Sometimes caution from the legal angle makes such a reply proper but this precaution has little application to the ordinary routines of business. Nothing is more discouraging than to expect some definite data from someone else and then receive information which is not only indefinite but valueless as well.

And Here Are More—

. . . Take the time to be friendly. Gruff, sharp attitudes, snide or critical remarks and sarcasm may be all right in a company of Marine recruits but they have little place in business. Friendliness is a top courtesy that sets off successful men and organizations.

. . . Avoid pulling the "emergency" lever unless you really mean it; such action infuriates one later to find out that it was all exaggeration and that no genuine "emergency" ever existed. Chances are we will receive little if any co-operation from the other party after doing this discourtesy just once.

. . . Sign your letter legibly or have your name typed below your signature. Have you ever wanted to make a personal contact with someone immediately after receiving a letter but couldn't make out the signatures thereon? Do not glory in an unreadable signature.

. . . "When you make a promise or a decision—keep it," is a most important courtesy. Any definite commitment or agreement should be followed up as promised or it should not be made in the first place. When a promise or commitment is given we present assurance that the other person can expect us to come through.

. . . When writing notes or letters seeking data or information always be sure to supply all of the facts. "Send us a widget for our grosmo machine," is the kind of request that not only fails to secure the "widget" for us immediately but causes high blood pressure in the man receiving the request. If we had specified the model number of the machine and details as to the particular "widget" we desired in the first communication it could have been shipped immediately; instead considerable (and useless) follow-up correspondence was necessary.

. . . When you "business borrow" pay back immediately. This includes everything from equipment to technical books. The chances are the man from whom you borrowed needs the borrowed items as badly as we do; if we let them lay around for days before returning them we have put that other individual to great inconvenience. It is a mark of good business courtesy to make prompt return on any such borrowed items the moment we have finished using thm.

. . . Make it easy for the other persons to supply information. Have printed forms made up covering areas in which we make many such requests. It's a lot easier for someone to fill in such a form with the requested information than it is to sit down and write it all out in a letter. Not only this but we are assured we will obtain just the information we desire when following such a routine.

This "baker's dozen" of suggestions is not all inclusive and may not all be the most important, but they are worth remembering, don't you think?

Yours,

Joe

Ed. Note: Joe is actually Ernest W. Fair, a technical journalist of Boulder, Colo.

W & SW

TECHNICAL DIGEST

Oxygen Demand of Leaves in Water

by E. SHERMAN CHASE and A. F. FERULLO

ACCORDING TO the authors, "Natural pollution may be defined as the material, organic and inorganic, washed or blown into streams and lakes from woods and fields, cultivated lands and country roads. Particularly significant in water supply reservoirs are the autumn leaves blown or washed therein. These leaves, when waterlogged sink to the bottom and in the process of slow decay exert a long continued demand on the dissolved oxygen of the overlying water."

So far as the authors know, few data exist on the oxygen demand exerted by leaves over an extended period. This study was made to obtain an estimate of the amount of oxygen used up by the decomposition of leaves when stored under water for many days in excess of the conventional 5-day B.O.D. period of incubation.

Method of Study

Autumn leaves and pine needles were used. The method of conducting the study is described briefly as:

One gram of dead maple leaves and four grams each of dead oak leaves and fallen pine needles (all air dried weight), were submerged in 5 gal of Boston tap water in carboys. Sixteen ounces of water from a water supply pond in Marlborough were used as seed in each carboy.

Provisions were made to prevent oxygen absorption from the air by the water. Temperatures ranged from 20 to 29° C., averaging 25° C. At intervals samples were removed for D. O. determinations. Each time a sample (one quart) was removed, an equivalent amount of fresh water was added and the mixture aerated. After aeration another quart of water was removed for a D.O. determination. The total water removed and replaced during the test was equivalent to 9.75 percent of the total volume. The tests were carried on for a period of 386 days.

Since the Boston tap water had an oxygen demand of its own, a correction had to be made when calculating the oxygen demand of the leaves. The oxygen demand of the Boston tap water is shown in Fig. 1. The curve has been corrected to the average age of the water, that is corrections have been made to take into account the incremental withdrawals and additions made during the long test period. (The paper describes the method of determining the curve in Fig. 1.)

One of the problems of the test was to exclude algae growths and effects in the carboys, particularly in the maple leaf test. Excluding light from the carboys and calculating corrective factors were employed to offset this problem.

Results

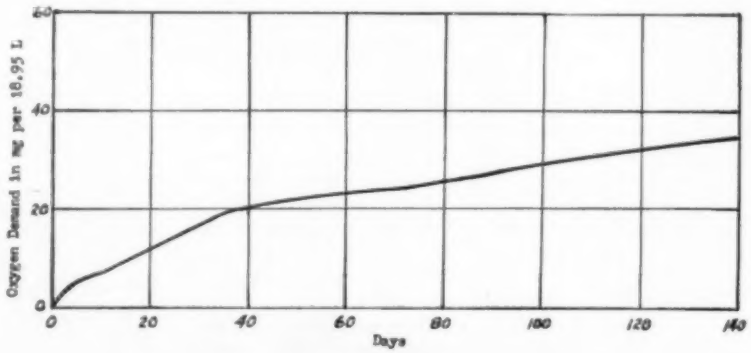
The results of the tests are shown in Fig. 2, together with the 140-day test on tap water, corrected as indicated.

The relative demands of the three types of leaves and of the organic matter naturally present in the tap water, indicate that the tap water itself exerted only a small effect upon the other three curves. If a correction were made for the oxygen demand of the tap water, the other curves would be modified but slightly. The condition most affecting the maple leaf curve was the growth of algae.

Although algae growths obviously affected the oxygen demand of the maple leaves, it is probable that the shape of the curve, without algae interference, would have been as shown by the dot and dash line.

It should be noted that removal of water from the carboys for D.O. determinations, also removed some dissolved organic matter leached from the leaves. No determination of the effect of such removal was made and was considered unwarranted under the circumstances, as the probable error was offset in part by the addition

Mr. Chase is a Partner and Mr. Ferullo, a chemist, Metcalf and Eddy, Cons. Engrs., Boston, Mass. Their paper was presented at the March meeting of NEWWA, in Boston, Mass.



Oxygen Demand of Tap Water

Fig. 1.—OXYGEN demand of Boston tap water.

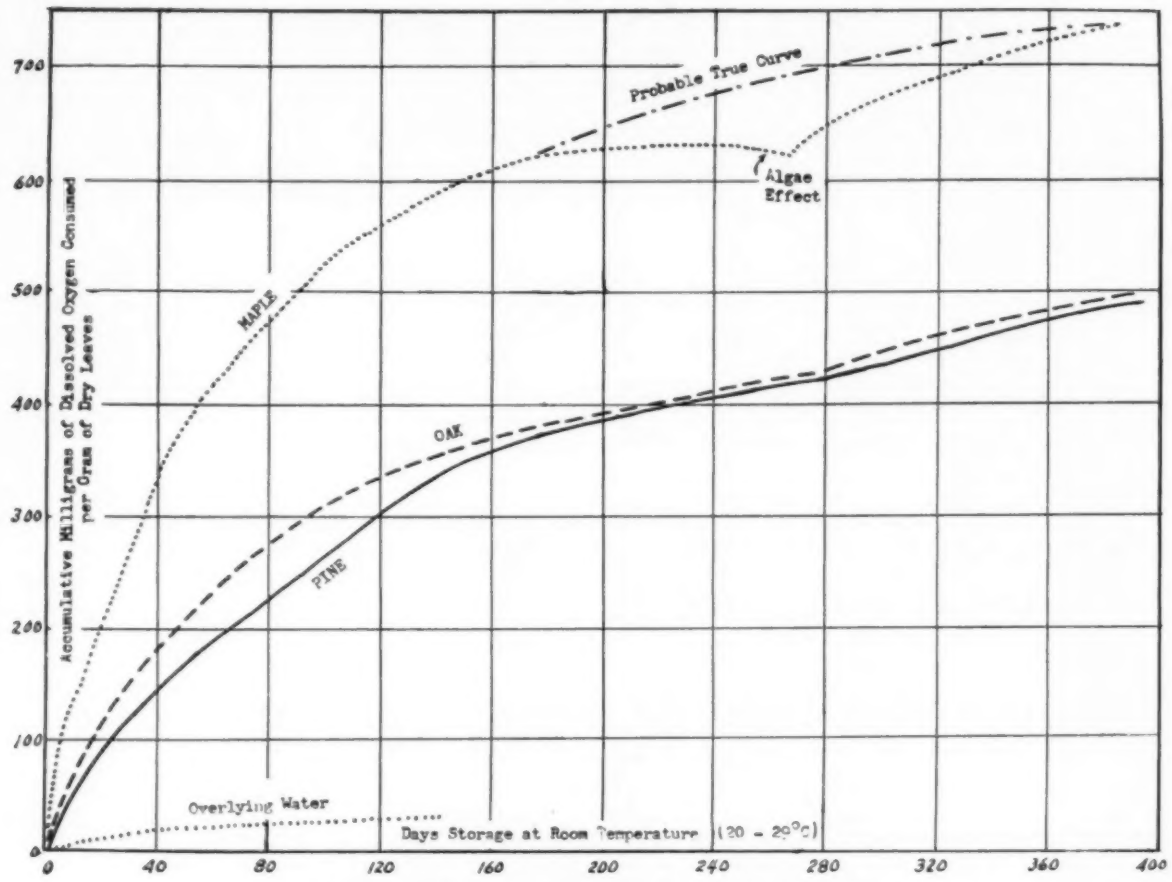


Fig. 2—OXYGEN removed from overlying water by fall leaves.

of organic matter in the tap water.

The curves in Fig. 2 are not precise but they are reasonably accurate and do show the long continued oxygen demand of so-called "natural pollution" under aerobic conditions. The curves indicate that maple leaves have an oxygen demand under aerobic conditions, equivalent to 75 percent of their weight. Oak leaves and pine needles, on the other hand exert a demand of 50 percent of their weights under similar conditions.

Conclusions

Obviously, leaves in reservoirs, under natural conditions, do not exert the same oxygen demand as they do in laboratory tests. Temperatures in reservoirs vary widely, decompose under both aerobic and anaerobic conditions, overturns take place in spring and fall, and algae growths may develop. Except for the algae (in one instance) none of these conditions were factors in the laboratory tests. Nevertheless, the test does give an indication of the quantitative demand for oxygen exerted by leaves and the period of time over which such demand is exerted.

The authors concluded that "the application of this study to practical management of watersheds and of storage reservoirs is in the confirmation of the generally accepted use of conifers for watershed plantings and of the value of periodic flushing of bottom waters from behind dams."

Ordinance to Control Water Softeners Considered

The City Council of Santa Paula, Calif., is considering methods of controlling water softeners and other devices suspected of polluting the underground water supplies.

An ordinance now being considered would:

1. Require registration of all softeners now in use, both residential and commercial.

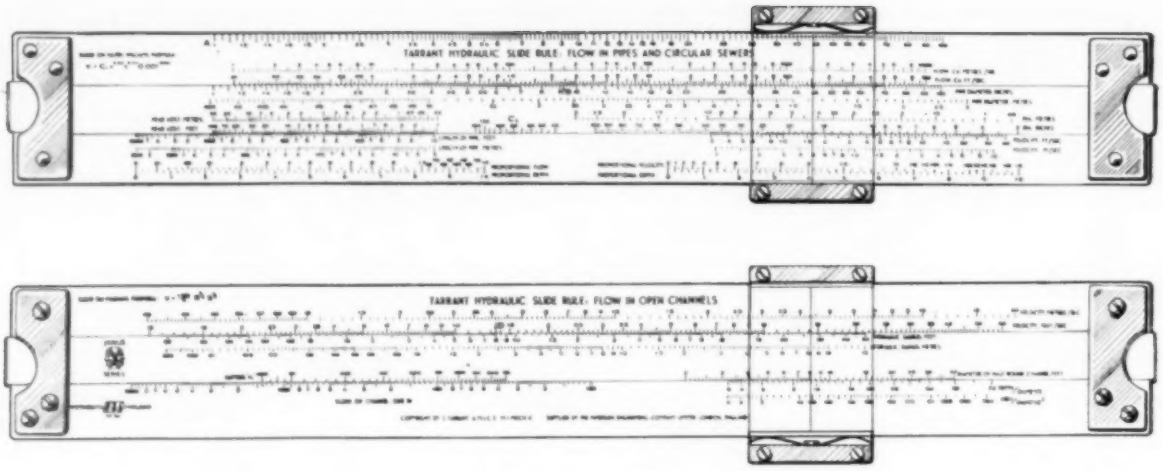
2. Prohibit the use of unregistered softeners.

3. Prohibit the installation of softeners in new homes, or the replacement of existing softeners, unless arrangements are made to dispose of their waste waters outside the city's sewer system. This would require the hauling of such wastes to an area where underground water supplies would not be endangered.

4. Prohibit regeneration of ion-exchange softeners.

5. Require the issuance of a permit to any commercial establishment which discharges more than 100 gallons of industrial wastes per day into the city's sewers, so that the city may curb discharges found harmful to the water supplies.

Good judgment often comes from experience gained through poor judgment.



BOTH HAZEN-WILLIAMS AND MANNING'S formulas for calculation of flow through pipes, circular sewers and in open channels, are incorporated in a new . . .

Hydraulic Slide-Rule *for sanitary engineers*

Designed by JOSEPH TARRANT, A.M.I.C.E. and M.I. Mech. Engr., Ruislip, Engr., it will soon be available in the United States.

■ ONLY 13 INCHES long, the "Tarrant Hyraulic Slide-Rule" has one side used for calculating flow in pipes up to 100 in. in diameter, running full; the other side is for flow calculations involving open channels. The former is based on the Hazen-Williams Formula; the latter on Manning's formula.

The Hazen-Williams Formula

On the Hazen-Williams side of the rule, scales are provided for flow, diameter of pipe, head loss, and length of pipe. When any three of these factors are known, the fourth can be found rapidly with a minimum of calculation. This side also contains a scale for determining velocity of flow.

The scales are calculated and arranged for $C_1 = 130$. An auxiliary scale on the lower edge of the slide allows for adjustments for other values of C_1.

By means of a set of proportional scales on the lower edge of the rule, the same information can be calculated for pipes and sewers running partly full. A scale is also provided for ordinary multiplication and division.

The Manning Formula

On the side utilizing the Manning formula, calculation of flow in open channels is possible. The scales on this side of the slide-rule are for velocity, hydraulic radius, slope of channel, and Kutter's constant "n". The hydraulic radius for channels bounded by straight lines can be determined easily and directly; for half-round channels, having a depth of flow up to half the diameter, the hydraulic radius and area of flow can be calculated by the use of an additional set of scales.

The slide-rule contains both English and metric units on both sides. English units are printed in black, metric units in red. The slide-rule has the accuracy of a normal slide rule with a ten-inch scale. It is marketed by Paterson Engineering Co., Ltd., Windsor House, Kingsway, London, W. C. 2.

For many years alignment charts have been used as a means of simplifying the calculation of flows in pipes and sewers, and there have been slide rules developed for the same purpose by several engineers. This one replaces several alignment charts; it differs from other slide-rules in several respects, notably its size and construction and the inclusion of the metric scales as well as combining both the Hazen-Williams and Manning's formulas onto one rule. Engineers engaged in hydraulic calculations will find this slide-rule a new tool to reduce the time required for determinations connected with the flow of water through pipes, sewers and open channels.

Art or Science? Meteorologist or Charlatan? Fact or Phenomenon? Benefactor or Swindler? These are all involved in . . .

Cloud Seeding: Hope or Hoax?

by JOHN A. DAY, Department of Physics, University of Redlands, Redlands, California.

■ APPROXIMATELY A DECADE has passed since the advent of commercial cloud seeding. A legitimate question which any layman might well ask is whether cloud seeding has been shown to have a sound basis for hope, or whether there is evidence of a hoax having been perpetrated on the public.

Water—The Common Substance

Water is the most common substance on earth yet it has a valid claim to being a very remarkable substance. It not only is the only substance which is found in the natural state as a solid, a liquid and a vapour but it is the only inorganic fluid which occurs in appreciable quantities.

Water covers over three fifths of the surface of the globe, 97% of it being in the seas and oceans, one third of the remaining 30th part being in snow and glaciers, one two thousandths per cent being in the atmosphere and the remainder comprising the fresh water of rivers, lakes and ground water.[1]

Molecules of water are continuously being evaporated from sources of liquid water and as vapor mingle with the other gases of the atmosphere, by various means are lifted in the atmosphere, gather together about a suitable nucleus as droplets of water or as snowflakes, and when heavy enough, fall back to the earth thus participating in that vast cyclic phenomenon we call the water cycle.

Water is so common, and man takes water so much for granted, that he does not realize just how much he is dependent on water for his livelihood until he does not have enough. Then he desperately starts to cast around to see what he can do about it.

He finds that he has four choices, none of which are inexpensive. He can build larger storage areas; he can transport water from a water-surplus area; he can desalt sea water; he can attempt to make the atmospheric processes more efficient, i.e. he can engage in cloud seeding.

Rainmakers—Use Varied Techniques

In civilizations where man believes in a capricious God who can be appeased, one finds ceremonial dances performed by members of the tribe to intercede with God for rain. One can see this phenomenon acted out by the Indian tribes of the Southwest. Overtones of this point of view crop up in unusual places. One is likely to see a newspaper clipping datelined from any drought area telling of such and such a congregation meeting in special session to pray for rain.

Man himself has always had dreams of doing something about the rainmaking problem. Some of the dreamers were men with scientific attitudes. The attempts which they made a hundred years ago were rather crude and were not based on much basic understanding of the atmospheric processes, but they were a start. Other dreamers were charlatans, pure and simple, whose principal motivation was the dollar sign. The recent motion picture "The Rainmaker" with Burt Lancaster and Katherine Hepburn was a memorial to this type of individual.

A few eccentric geniuses of this latter breed are still to be found. For example, the Redland's "Facts," Redlands, Calif., recently carried an account of a visit by Mr. C. P. Weatherford, a self styled professional rainmaker. (Note the name.) Weatherford claims to have received a gift of making rain by "Thought Projection" at the age of 24. He thinks "let there be rain" and the rain follows. The cause of California's drought—according to this expert—is that there are too many "negative thinkers"!

The Scientific Approach

The scientific community started to become serious about the problem following an historic weather modifications experiment by Drs. Langmuir and Schaefer on November 13, 1946 when they dropped dry ice from an airplane into a super-cooled cloud. This event awakened much interest. The second important advance which stirred the thinking of the meteorological profession was the discovery by Dr. Vonnegut a year later of the ability AgI crystals had to transform a cloud of super-cooled water droplets to ice crystals.

The experimental work of Schaefer and Vonnegut spawned the art or the science—as you will—of commercial cloud seeding, for it was only too logical to expect that people who did not have enough water would pay to have their water supply replenished from the atmosphere despite the element of uncertainty involved.

Today we may as well admit it. Cloud seeding is big business. Hundreds of thousands of acres are being seeded. Fees of millions of dollars have been paid for cloud seeding in the last ten years by organized groups: ranchers, public utilities groups, orchardists, water control districts.

The cloud seeder is not the only person interested in this subject. During

the period 1950-55 over 500 scientific articles dealing with the subject of weather modification were printed in the scientific journals. Probably over a few thousand papers have been written since the original experiments 10 years ago. One might think that with this effort the subject had been rather completely dealt with. On the contrary the feeling of the scientific community is that the surface has just been scratched, and that one of the crying needs in the country is for an expanded program of basic research in cloud physics to bring out a better understanding of the precipitation processes.

The Theory of Cloud Seeding

For the benefit of those who might not understand the sequence of events involved in a cloud seeding project, let us review them briefly.[2] The hypothesis on which cloud seeding is based is that precipitation ensues only when water aggregates become heavy enough to fall out of a cloud mass. It is known that super-cooled water droplets are common in clouds that extend higher than the 32 degree level. Further, it can be shown that if an ice crystal and a super-cooled water drop happen to be side by side the ice crystal will grow at the expense of the water droplet due to the vapor pressure gradient that exists between them. If there is a deficit of ice crystals in a super-cooled cloud over that required for this event to occur efficiently, the cloud seeder (making use of Vonnegut's discovery of the close physical resemblance of AgI and natural ice) says in effect "I will generate AgI crystals, I will try to place my generators in such a position that these crystals will be wafted into the portions of the cloud where there is a significant amount of super-cooled water in droplet form, and I will make up Nature's deficit so the precipitation process can precede as efficiently as possible."

As storms move into the area generators are turned on by direction when seeding opportunities arise. Data of various kinds are gathered. When the project is concluded the next phase gets underway—namely, the evaluation of results. Here is where the trouble begins. Despite the fact that all concerned would like to know if cloud seeding "works" or "doesn't work" the nature of the problem is such that the answer to the question simply can't be given in these terms.

The basic challenge which Nature hurls at the evaluator is: 'I dare you to determine what would have happened naturally, had the cloud seeder not been at work.' In view of the extreme complexity of the various interactions between those factors which produce "The Weather," this is a challenge which can be responded to only through statistical methodology.

Statistics is a powerful tool which enables us to extract useful information from highly variable data. It may enable us to extract wisdom from data, but it can never be used to put wisdom into data. Another way of stating this issue is: 'from crude data the statistical implications must perforce be lacking in precision.' A recent rather popular book was titled "How to Lie With Statistics." In this the author was trying to remind the general public that statistical methodology can be mishandled, both through ignorance and by intent, and that illustrations of "come-one" bolstered by bad statistics are rife. Just stop sometimes and examine carefully the advertising one sees on TV! The possibilities for mishandling statistics in connection with commercial cloud seeding are there for the taking! This is one of the 'sand bars' upon which the cloud seeding issue is now aground.

The Hope

What, if any, are the bases of hope in the area of weather modification? One basis of hope lies in our experience resulting from conduct of basic research in other areas such as nuclear physics, guided missiles, polio, etc. In proportion to the time and money expended on basic research in the area of cloud physics we can be confident that we will come to understand the precipitation process. When we understand what activates the precipitation process and how it proceeds through a life cycle then cloud seeding may be carried on as a scientific-engineering activity. This is true in a degree at the present time but it would be true to assert that most cloud seeding today partakes as much of being an art as it does of being an engineering science.

Can we be optimistic today about the possible benefits now available from cloud seeding? According to a recent comprehensive summary by D. W. Cline of the U. S. Weather Bureau[3] the present evidence drawn from all projects which have been conducted and evaluated to date is that "the immediate possibilities are somewhat less promising than most of us had hoped." One of the sobering facts that seems to emerge as extremely relevant is that plentiful supplies of super-cooled water droplets are not abundant in most clouds, and that cloudseeding is effective to the degree that clouds being seeded do possess just this characteristic of abundant super-cooled water.

The Hoax

Is there any evidence of hoax? The issues involved in the perpetration of a hoax are subtle, and one who points a finger can easily be misunderstood. It is an issue akin to the category of 'sins of omission.' Has a cloudseeder perpetrated a hoax if he (in ignorance of the physical facts of the precipitation process) convinces a group of men (in need of water) that he can markedly increase the rainfall or stop the formation of hail, then in his enthusiasm produces an evaluation that is consistent with his claims by choosing the method of handling and interpreting the results? We leave this to the reader's judgment.

Protection from Hoaxers

What are the ways in which a potential client can safeguard himself against a hoax? There are several:

First, he should advertise and solicit bids for a project from persons who are professional members in good standing of the American Meteorological Society.

Second, he should insist that the cloud seeder follow standard engineering practices, including: presentation of a detailed plan of attack on the problem at the outset, submission of regular progress reports, and a final report at the conclusion.

Third, he should insist on the importance of the evaluation procedures and see to it that the project is structured in such a way that a sensitive evaluation can be made. Since statistical methodology must be employed this will probably necessitate some form of randomization. An outstanding prototype of this type project is now being carried on in Santa Barbara County, California. This, incidentally, is a joint effort involving a

professional cloud seeder, the state of California, the U. S. Weather Bureau and the client.

Fourth, he should insist that the evaluation be carried on by a third party, and that the evaluation be submitted as a technical paper in one of the standard scientific journals.

The long range potentialities of weather modification are immense indeed. Someday we may be able not only to increase, but to decrease rainfall; we may be able to prevent hail. We might find ways of doing something even about tornadoes and tropical cyclones, though the energies involved in these phenomena are so tremendous that man's efforts are rather puny. To accomplish any of these things with no uncertainty as the effectiveness of results is still decades in the future.

At present we all have an obligation to see to it that the money which is spent on weather modification projects is well spent; we need to encourage more basic research. We must always keep a wary eye peeled for the psuedo-scientist who would take advantage of the opportunity to make a 'fast buck.' Following through on these points we have grounds for modest optimism about the accomplishments of weather modification efforts in the reasonably near future.

References:

1. Kuenen, B. H., Realms of Water, Wiley (1955).
2. At this point one should differentiate between a scientific and a commercial project—not that the two need to be radically different—but in history they have been different in certain respects. The former is planned with the end result of acquirement of increased understanding. The latter is carried on for the primary purpose of making a profit. This is not to be condemned per se, for this is the motive of all commercial enterprises. There are, however, certain obvious attendant responsibilities.
3. Presented to the Missouri Basin Inter Agency Committee at St. Joseph, Mo., March 20, 1957.

Pickup's from Purdue's "Sanitary Engineering News"

Don E. Bloodgood, Editor

When concentrated raw sludges in the order of 8 to 10% total solids are handled the pipe friction losses may be six to eight times the losses when water is used.

* * *

The system under which sprinkling is permitted at odd and even numbered homes on correspondingly numbered days proved the least objectionable and yet accomplished the desired effect.

* * *

Lake Mead, which backs up behind Hoover Dam, lost 796,000 acre feet of water in 1954 and 699,000 acre feet in 1955 by evaporation. These amounts lower the lake level more than seven feet per year and are losses of more than 635 million gallons per day.

* * *

The recent outbreak of infectious hepatitis in New Dahli, India, presents new evidence that this viral disease can be spread by a muncipal water supply treated with flocculation, rapid sand filtration and chlorination.

* * *

I have heard of "bats in the belfry," but owls in Baltimore, Md. sewers was news.

* * *

As a result of 30 years of experience with various methods of well maintenance in Lansing, Mich., it has been concluded that dynamiting is by far the best way to control decline in yield caused by plugging of a well.

* * *

Relatively new to the coagulation field are cationic coagulant aids. Laboratory tests have revealed that filtering a water clarified with alum, plus a cationic polyelectrolyte, increases the filter runs about 50%, compared to filtering a water clarified only with alum.

* * *

Temper gets you into trouble; pride keeps you there.

* * *

It is reported that 17.2% of the community supplies are owned by private water companies and that publicly-owned supplies decreased and private systems increased from 1948 to 1954.

* * *

Field evaporation studies are currently being conducted at Rattlesnake Reservoir, a 100-acre lake near Denver, to develop a feasible technique for application and maintenance of a monomolecular layer of hexadecanol on a large reservoir.

* * *

Built in 1952, the trickling filter plant in Panama City, Fla., won honors in 1954, 1955, and 1956 from the Florida State Board of Health as "the best operated trickling filter plant in the State."

* * *

The International Correspondence Schools of Scranton, Pa. give: (1) Water Works Operator Course and (2) Sewage Plant Operator Course by correspondence.

* * *

Fourteen states have passed laws which would reimburse utilities for relocation costs because of highway reconstruction or relocation.

* * *

There will be 100 nuclear power plants in the United States by 1965, according to G. R. Molesworth, head of a New York public relations firm and former assistant to the manager of Oak Ridge operations for the Atomic Energy Commission.

* * *

The Public Utility Advertising Association has presented three first-place awards to the Indianapolis Water Company for its 1956 advertising and public relations program.

* * *

Copper in amounts lethal to some fish may be absorbed in water from copper pipes used in domestic plumbing. (*Wat. Life*, 10, 124-25, 1955).

* * *

Water Use and Sewage Volume

Motels	51	gpcd.
Trailer Courts	49+	gpcd.
Rest Areas (per capita)	7	gpcd.
Drive-In Theaters (per car)	5	gd.
Restaurants (per meal)	5	gal.

* * *

Sennacherib's Aqueduct of Jerwan, built in 691 B.C. brought clear mountain water to Nineveh. It probably was the first real municipal water supply.

* * *

The Magnolia Oil Co. has purchased an option on Midland, Texas sewage treatment plant effluent for use in "black pressuring" oil wells in west Texas. The effluent must be delivered free of sulfur bacteria.

* * *

Correct length of the well screen has much to do with good construction and performance of a completed well. If the screen is too long, the cost of the well is increased unnecessarily. If it is too short, the yield of the well may be unsatisfactory.

From fundamental concepts of sedimentation and experimental studies comes an improved sedimentation tank, termed simply . . .

The Uniflow Tank *Part I*

By JAMES L. DALLAS, Associate Sanitary Engineer, Massachusetts Department of Public Health, Boston, Mass.

PART I of this article contains the basic theory on which the design of the Uniflow Tank was developed and presents the principal features of design and influencing factors. The article was presented as a paper at the Second Waste Treatment Conference of Manhattan College in New York City, and is published here by permission of the College. Part II of this article will appear in a forthcoming issue of *Water & Sewage Works*.

■ THE DESIGN of settling tanks for treatment of sewage and water has been a principal subject of study, experimentation, research, and practical application for more than half a century.

Experts in hydraulics and practical designing engineers have theorized and agreed on many of the factors influencing the design and efficiency of tanks to permit the settling out of solids suspended in a liquid. There is general accord in some areas of theorization and statements of phenomena involved; but in certain other aspects, such as the influence of horizontal velocity on the efficiency of tank performance, there is still considerable disagreement among outstanding hydraulic engineers.

In application of the theories to the design of tanks, considerable difficulty is often encountered because the liquid in the tank (for one or more of many reasons) does not always behave so as to conform to the basic assumptions and conditions upon which the theories were evolved. Furthermore, the actual design often incorporates certain physical features and characteristics in an attempt to establish conditions in accord with the assumptions of the theory.

As an example of this point, inlet weirs, ports, and baffle designs have quite frequently attempted to distribute the flow uniformly over the whole cross-section of the tank because such was a basic condition of theory. One might, however, philosophically ask: "If it is desired to settle out the solids on the bottom of the tank, why is it not more logical to let the liquid start its unloading process near the bottom and as it becomes clarified permit it to rise to the surface for removal?"

This is, of course, substantially what occurs in vertical-flow tanks. It does not make sense, from the simple point of view of particle removal, to distribute the load of large and small particles so that a proportionate share will have to settle all the way to the bottom. Neither is it desirable to redistribute or reverse the suspended load portion, as occurs in some multi-tray tanks in which the liquid passes from one tray compartment to another located above it and in series.

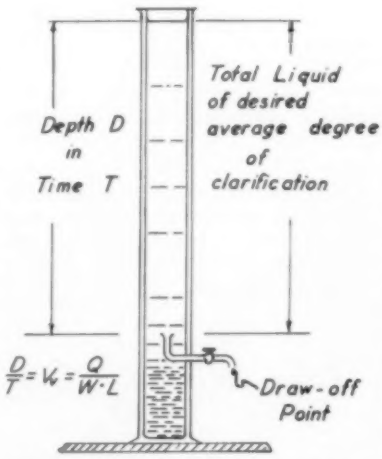


Fig. 1—APPARATUS for determination of overflow rate.

Many factors which affect the design of a tank and its efficiency obtain under different situations, varying conditions, and in different combinations. Some of these factors are:

1. Variation in quantity of flow.
2. Variation in density due to suspended load concentration, dissolved load concentration, and temperature changes.
3. Wind-induced currents.
4. Turbulence arising from inlet design.
5. Effluent design effects on flow path lines.
6. Type of sludge removal mechanism and its effect on flow within the tank.
7. Detention time, insofar as it should receive consideration for balancing of load on other units, effect on septicity, and volume of water and chemicals to be wasted in quick-draw-off tanks that may be used in water treatment without mechanical sludge removal equipment.
8. Relative cost of various shapes, sizes, and depths to which the designing engineer must give consideration.

It has been said that the average practicing engineer would appreciate having a few safe rules or guiding parameters for designing water treatment settling basins. This also would be desirable for sewage and industrial waste treatment plants. It is a recognized fact that many engineers are, for pragmatic reasons, chiefly and only interested in discussions and theories that lend themselves to practical application.

This paper presents, in brief, the fundamental concepts of sedimentation

upon which an efficient design of economical construction is evolved, and a design procedure that will be timesaving to the user, at least during the preliminary planning stage of design, and which guides him in the design within ranges of acceptable parameters but still permits the exercise of good engineering judgment based upon theory, empirical knowledge, and practical expediency.

Elementary Theory of Sedimentation

A review of the elementary theory of settling process as formulated by Hazen[1] in 1904 is here given as one basis upon which an improved settling tank design is logically evolved.

The following assumptions are made:

1. Particles are discrete and do not flocculate.

2. The flow is purely irrotational; (that is, streamlines and particle pathlines are straight or smoothly curved and there are no eddies or local irregularities in the flow caused by turbulence).

3. Particles striking the bottom remain fixed.

In a vertical column of still water, such as shown in Figure 1, a suspension will form a slowly falling blanket and a gradual clarification of the upper layers will occur. In an ideal basin (Figure 2a) of depth D and detention period T, with horizontal flow, for which the foregoing assumptions hold, the concentration of sediment remaining in the effluent will be the same as that in the tube of Figure 1 above a depth D, when sampled after time T. The settling velocity of a particle starting at the top and just reaching depth D would be

$$V_v = D/T \ldots (1).$$

If the length of the ideal basin were L and the width W, the pathline of this particle would be as indicated by line S in Figure 2b. Because the triangles of this figure are similar, the relation

$$V_v/V_h = D/L \ldots (2)$$

holds, where V_h is the displacement velocity and

$$V_h = Q/DW \ldots (3).$$

Therefore, it follows that

$$V_v = Q/LW \ldots (4).$$

The latter term is the overflow rate, the discharge divided by surface area. The implication of Eq. 4 is that all particles with a subsidence velocity of V_v, or larger, would be 100 per cent removed in passing through an ideal basin having an overflow rate, V_v. Particles with a smaller subsidence velocity, V_s, would be only partly removed, in the proportion V_s/V_v.

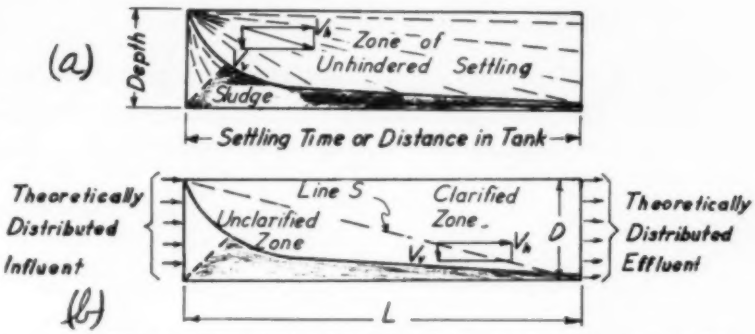


Fig. 2—"IDEAL" settling tank, showing: (a) paths of settlement and (b) settling zones.

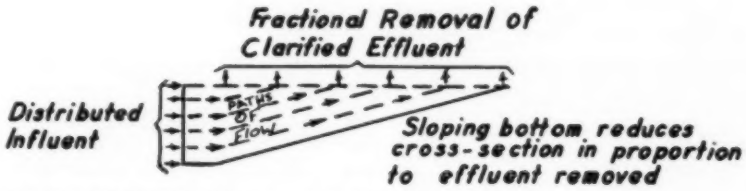
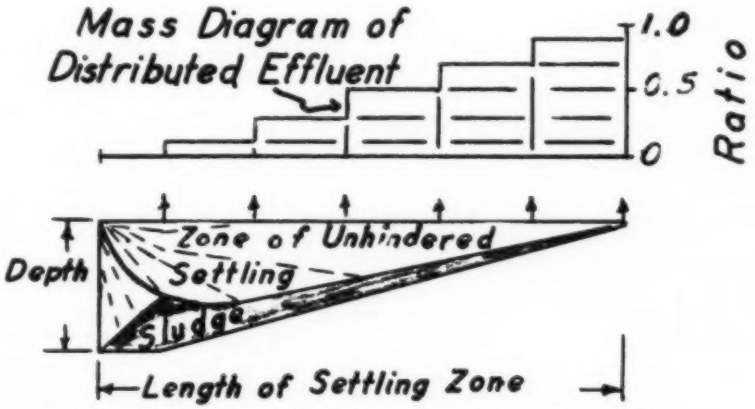

Fractional Removal of Clarified Effluent
Distributed Influent
Paths of Flow
Sloping bottom reduces cross-section in proportion to effluent removed

Fig. 3—MODIFIED settling zone in sloped-bottom tank.

The analysis shows that when flocculation is not manifest the removal efficiency depends (in theory) on the overflow rate and not on the depth of the basin. It may be shown that for other conditions of flow geometry, such as that with a weir outlet, in which streamlines are not horizontal but are inclined or curved, the same lack of dependence of efficiency on depth still obtains, provided the three initial assumptions previously given are valid. If these hold, it would be economical to design shallow tanks with large areas and with large displacement velocities.

With the non-ideal conditions that actually occur, the zone beyond the critical pathline still is relatively unimportant from a functional standpoint and serves no useful purpose except in an ancillary way in providing space for the reduction of weir drag. In a tank of triangular longitudinal cross-section produced by use of a radically sloped bottom (as shown diagrammatically in Fig. 3 and 4) the ineffective zone is eliminated. Streamlines extend obliquely upward toward a series of effluent troughs spaced at intervals on the surface.



Fg. 4—PATHS of settlement wtih sloping bottom and distributed effluent.

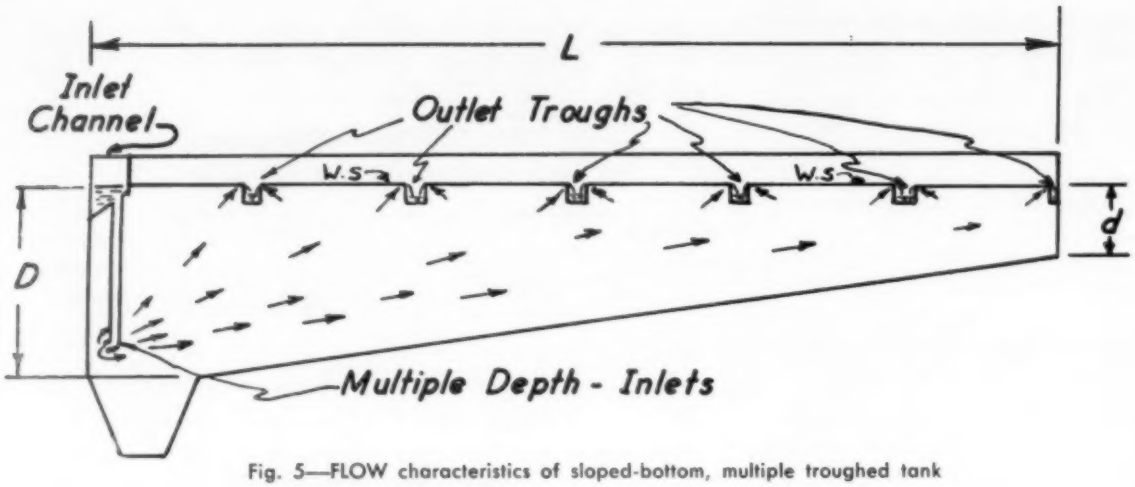


Fig. 5—FLOW characteristics of sloped-bottom, multiple troughed tank

Radically Sloped-Bottom Tank

Although the actual hydraulic conditions encountered in settling tank design seldom accommodatingly and completely conform to the assumptions on which the Hazen elementary theory is based and/or to the theory itself, an efficient and economical tank design may be evolved based on its concept.

In Figure 2 the pathline is shown of a particle with the smallest subsidence velocity of all particles that are 100 per cent removed. That is, if the ideal conditions assumed in the elementary theory obtained, all particles having this subsidence velocity would be completely removed. Insofar as such particles and all more rapidly settling particles are concerned, the volume of the tank above and to the right of this critical pathline makes no contribution to the settling performance of the tank. In theory, all particles, of any size whatsoever, entering this zone are not removed; hence, this volume is ineffective in settling.

With the arrangement shown in Fig. 3 and 4 there are a number of advantages, as follows:

1. The surface area is not reduced, even though the volume of the tank has been reduced by 50 per cent. Consequently, the overflow rate is not altered.

2. Despite the reduction in volume, the displacement velocity is increased only by an insignificant amount; the horizontal component of the velocity remains the same as in the rectangular tank.

3. At the upstream end the same amount of volume is provided for the dissipation of inlet turbulence as in the rectangular tank.

4. The slope on the bottom aids in the return of sludge. The flights need only nudge the sediment and it flows smoothly. With the smaller slopes conventionally used, the flights may plow through the deposit and disperse it upward into the flow.

5. As a consequence of the tapered profile and the presence of a number of weirs, the streamlines converge in almost all portions of the tank. This tends to increase settling efficiency, inasmuch as fluid tends to be more stable in regions of converging streamlines. In diverging flow, irregularities of motion persist for greater distances.

6. With the adverse slope on the bottom there is less tendency for slugs of dense fluid entering the tank to short-circuit along the bottom at high velocities directly toward the outlet. Density currents of this character derive from slugs of cold fluid or fluid with higher than average solids concentration. In addition to causing short-circuiting, they introduce added turbulence in the tank. Density currents are often an important factor in reducing efficiencies in tanks of conventional design.

In Fig. 5 the basic design is shown with two modifications. The first is that the depth *d* at the downstream end cannot be zero, but must be at least 4 ft in order to accommodate sludge removal mechanisms now commercially available. This still permits a saving of one-fourth to one-third of the volume of a conventional rectangular tank with the same overflow rate. In tanks without mechanical sludge removal equipment, the downstream depth may be made small, and the theoretical upper limit of a saving of one-half the volume may be approached.

The second modification is that the inflow may be introduced in a series of down-pipes across the tank as shown. With the flow entering near the bottom the likelihood of high-velocity density currents is reduced. Moreover, the arrangement lengthens the pathline to the nearest outlet weir and tends, in part, to secure the advantages of upflow tanks. With some types of waste, the arrangement promotes the formation of a sludge blanket and clarification is thereby enhanced.

A number of design features applicable to a full-scale installation are indicated in Fig. 6. The scum removal trough in primary tanks is located just upstream from the first weir. Inflow is guided downward by a baffle extending 50 per cent of the distance to the bottom of the tank and submerged 2 inches below the surface to allow escape of scum from this inlet portion of the tank.

It is evident that this design does not attempt to distribute the influent uniformly over the entire cross-sectional depth at the inlet end of the tank or to start all the flow through the settling zone in paralleled horizontal paths. However, the baffle, by extending to 50 per cent of the tank depth, does deliver the influent across the entire area of the settling tank inlet, which in this instance is the area between the bottom edge of the baffle and the bottom of the tank. The large water mass of the tank here encountered dissipates the influent turbulence

and the radically sloped bottom counteracts density-induced currents if they are formed. If the sewage as it enters happens to be "light," it is partially mixed with the dense sewage in the zone and a tendency to quickly balance and stabilize itself maintains.

If the mixture has a tendency to rise to the top portion of the zone and then to travel horizontally through the tank to the outlets, conditions approaching those of the ideal tank with smooth flow will exist in this effective settling portion of the tank.

If the mixture is dense and the liquid gradually rises through the sludge blanket to all the outlets, then in effect a vertical flow condition will prevail.

In either event, the same overflow rate, Q/LW, equal to the settling velocity of the critical-size particle of removal and the same critical displacement velocity, Q/DW, influencing scour, will exist and justify use of the same design parameters.

On the basis of this reasoning the tank will perform equally well under the two conditions as extremes and could be expected to perform satisfactorily under a variety of conditions existing between these two ideal extremes.

Certain Features of Design and Influencing Factors

Inlet Design

In a tank of typical conventional design the kinetic energy of the inflow that is dissipated in the tank is of the order of 100 to 1,000 times as large as the potential energy lost by the sediment in settling out of the flow. If only a small portion of this inlet energy is expended in such a manner as to interfere with settling, the reduction of efficiency may be considerable. Turbulence engendered by inlet energy is hard to control and design of a good inlet arrangement is difficult. Schemes that look good on the drawing board are likely to give disappointing results when installed.

Three methods are available for the elimination of inlet energy, as follows:

1. The kinetic energy may be reduced by providing for velocity head recovery. This may be accomplished in conical pipes tapered at an angle of about 10 degrees. Such expanders are expensive and are apt to be inconveniently long.

2. Provision may be made for baffled vestibules, separated from the settling compartment by perforated or slotted plates, to distribute the flow uniformly over the cross-section. Such arrangements require considerable space and may entail a sizeable drop in the energy gradient to accomplish the requisite degree of flow distribution. Moreover, the kinetic energy of jets from small orifices or slots is not dissipated in a short distance. Tests show that the centerline velocity in the jet from a small orifice discharging into a large body of fluid decreases to about 60 per cent of the initial value at a distance of 10 diameters downstream, and falls to 6 per cent at a distance of 100 diameters. Thus, installation of perforated plates or slots in the flow does not eliminate excessive turbulence for an appreciable distance on the downstream side in the sedimentation zone. In addition, it is difficult to prevent septicity in elaborately partitioned entrance chambers, particularly those having baffles in the horizontal plane. Such considerations have led most designers to resort to the third method of handling inlet kinetic energy.

3. Tanks may be made larger so as to provide additional space and

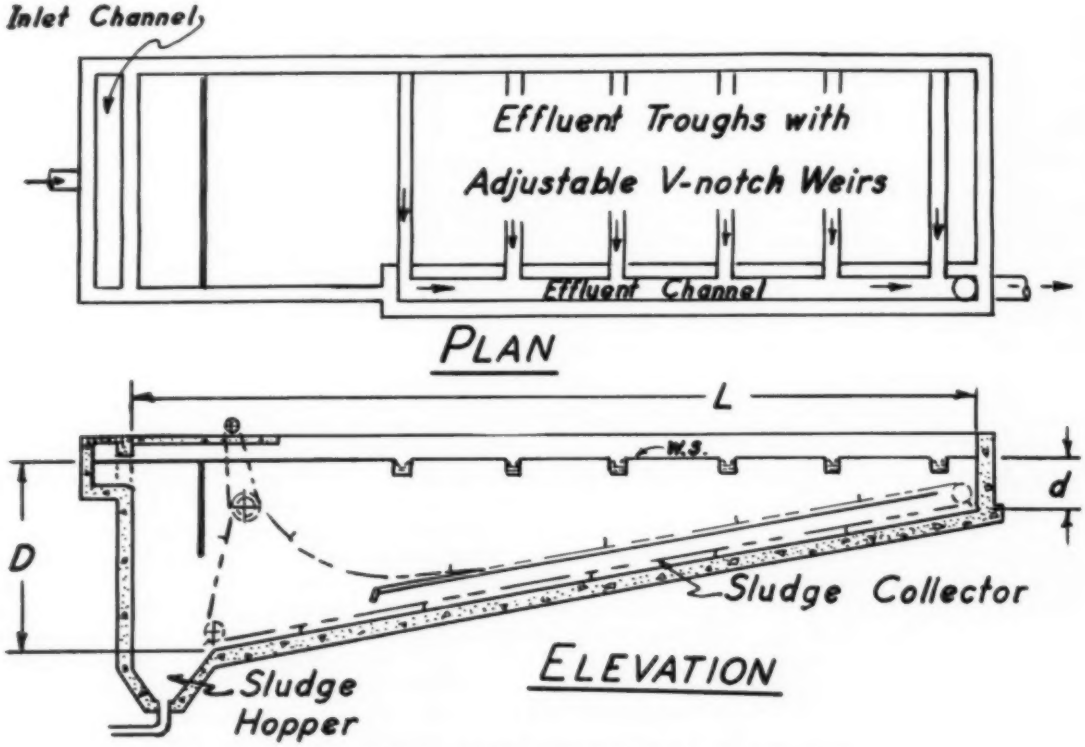


Fig. 6—TYPICAL installation of radically sloped-bottom tank.

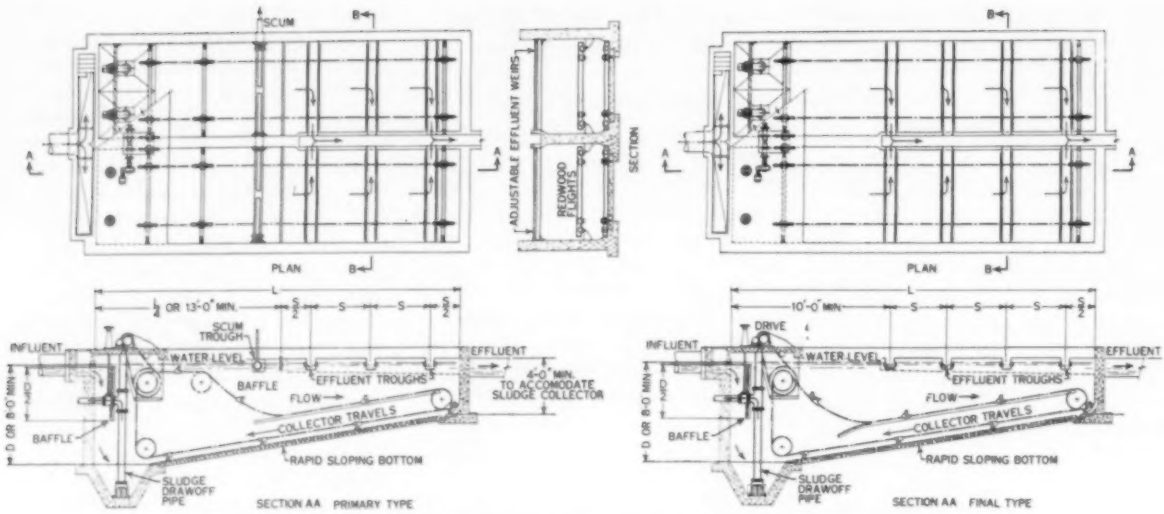


Fig. 7—LAYOUTS for primary-type (left) and final-type (right) uniflow tank.

mass for the dampening of the inlet turbulence. This practice is similar to that used in breakwater design at harbor entrances, in which the economical solution is to provide a large outer harbor for use as a stilling basin. If this method is relied upon for handling inlet energy, the specification of a minimum detention period by state health departments is rational, inasmuch as it amounts to fixing simultaneously an upper limit on the overflow rate and a lower limit on depth ($T = D/V_v$). In this way a satisfactorily small overflow rate may be obtained without allowing excessive shallowness. In the case of the uniflow tank, this critical depth is maintained at the inlet end and is arrived at on the basis of critical displacement velocity.

Detention time is not a design parameter because of the very basic theory of its design; a conventional tank includes the ineffective portion in the theoretical detention time, whereas the uniflow tank eliminates it. The detention time of the uniflow tank is not to be compared in all instances with that of the conventional flat-bottomed tank.

The suggested design does provide space and mass to dampen the inlet turbulence. The zone between the inlet channel and baffle (Fig. 6) is functionally similar to a "large outer harbor," where recovery of velocity head also occurs. Further, the influent as it emerges from the actual inlet (at the bottom) engages the large mass in the bottom of the tank and at a point substantially remote from the outlets.

If the settling tank is preceded by a flocculation or aeration tank, features of design incorporating continuity of structures (or very large connecting conduits between the two) provided with vanes to counteract rotational currents would be most desirable.

Bottom Scour

The inlet design features previously discussed are expected to produce a substantially uniform velocity distribution in the inlet part of the settling zone of the tank. The theoretical velocity at this point, however, even if very uniform flow conditions prevail, may be twice that existing in any other portion of the tank, depending on the type of flow (uniform vertical or uniform horizontal) that prevails. The sludge at this location is most dense, however, due to the greater proportion of larger and denser solids that settle out in this first portion of the tank and the incidental concentrating action of the sludge removal mechanism, and therefore will present considerable resistance to scour.

The critical scour is more likely to occur at the farther end of the theoretically zero-end-depth tank where the lightest particles are concentrated by critical horizontal displacement velocity resulting from either uniform horizontal flow or vertical flow conditions.

Ingersoll, McKee and Brooks[2] recommend that the ratio of critical tank displacement velocity V to the settling velocity of the critical size particle of removal v should be less than 9 to 15 to prevent incipient scour.

This parameter provides a basis for determining the cross-sectional area required (or depth for a given width) at the inlet end of the tank. Discussion of the same paper by Camp presents arguments for use of a higher value of V/v. However, use of the lower, more conservative, values recommended by Ingersoll *et al* would seem desirable, as they are within the time-proven and accepted range of 1 ft per minute and because the resulting deeper tank has other concomitant benefits.

Scum Removal

Unless the tank when used as a primary tank is preceded by special scum removal works, a scum baffle with trough or other removal device should be located sufficiently distant from the inlet end of the tank and ahead of any effluent weirs to permit surface capture and retention of that percentage of floatable grease deemed advisable for removal. The surface area actually necessary to accomplish this is theoretically a function of the rate of sewage flow and the rising velocity of the smallest or critical-size floatable particle to be removed.

Simple skimming tanks have been designed with detention times in the range of 1 to 15 minutes and with loading rates in the range of 10,000 to 300,000 gpd per square foot.

It is suggested that the scum baffle be located about one-fourth the length of the tank from the inlet. In general,

for overflow loadings in the range of 900 gpd per square foot, this would provide detention of about 30 minutes for grease removal and a surface area loading of approximately 4,000 gpd per square foot of surface area.

Other Factors Favoring the Suggested Design

The multiple weirs spaced along the surface encourage use of low weir loadings (thereby reducing weir drag), produce greater hydraulic stability through maintenance of converging streamlines in more portions of the tank, and reduce wind-induced surface currents.

The volume of the tank being less than the conventional flat-bottomed tank, and its natural counter-density-current characteristic, combine to cause the tank to adjust itself more quickly to changes in density and temperature of influent sewage, with reduction of short-circuiting and deleterious effects associated therewith.

Figure 7 shows details of both a primary and a final type uniflow settling tank design incorporating use of the ideas presented in this paper.

Although these drawings show the application of this theory to a rectangular tank design, its application to circular tank design is recognized and easily understood. Use of the radically-sloped bottom would considerably help and facilitate sludge collection, particularly in the case of circular tanks.

The shape of the tank indicates the possibility of savings in excavation and other construction costs, while at the same time maintaining high efficiency under varying conditions.

(Ed. Note: Part II will appear in a following issue.)

U.S. Public Health Service Progress Report

A summary of activities of the Water Supply and Water Pollution Control Program of the U. S. PHS for 1957 has been released. Following are excerpts of the report.

"At the beginning of 1957, major emphasis was still being given to getting the new program of construction grants for municipal sewage treatment works into operation. Since then, there has been a gradual reorientation toward a balanced program which will, within the limits of available appropriations, encompass all activities authorized by the new legislation and required by other Public Health Service responsibilities in water supply and water pollution control.

"Significant progress is reported for 1957 in several areas of the overall water pollution control program. Advances have been made in research on water, sewage, and industrial waste treatment processes and techniques; States have been able, with the assistance of Federal program grants, to expand their water pollution control activities and provide increased service in this field.

Grants for the Construction Of Sewage Treatment Works

"The Federal Water Pollution Control Act of 1956 authorized annual appropriations of $50 million, up to a total of $500 million, for grants to assist municipalities in the construction of needed sewage treatment works. The purpose of this financial aid, as stated in House Report 2190, 84th Congress, on the new Act, is to accelerate local programs of treatment works construction by providing an incentive to take action now to clean up the waters of the country!

"For the fiscal years 1957 and 1958 the Congress appropriated a total of $95 million to remain available until June 30, 1959. This grant program is being administered in close cooperation with the State water pollution control agencies and is now reported to us as operating very satisfactorily. The actual machinery for offering grants has been in operation a little more than one year.

"As of December 31, 1957, a total of 1,500 applications for grants had been received by the Service and State agencies. Of these, 828 projects had been approved, and grant offers totalling over $69 million had been made to support sewage works construction costing nearly $334 million. These hundred and fifty-eight of the grant projects were under construction by the end of the year and these had a total cost of $160 million, including $31.7 million in grant funds. Construction of 47 other grant projects has already been completed. Application for the other 672 projects that have been received but for which grants have not yet been approved, request funds totalling $69 million to support construction totalling $605 million.

"During 1957, 75 per cent of all contract awards for projects receiving Federal grants went toward new plant construction as compared to the 1952-56 national average of 48 per cent. This marked increase in new plant construction under the Federal program, and the fact that communities of less than 125,000 population have received the large bulk of the grant offers (92 per cent), indicate that construction grants have stimulated the abatement of pollution from many smaller communities which have heretofore been unable or unwilling to proceed with construction of needed sewage treatment works.

Program Grants

"The new Water Pollution Control Act authorized annual appropriations of up to $3 million, for 5 years, 'for grants to States and interstate agencies to assist them in meeting the costs of establishing and maintaining adequate measures for the prevention and control of water pollution.'

"From the total of $5 million appropriated for program grants for fiscal years 1957 and 1958, $2,668,300 was available during calendar year 1957. Of this amount, $2,328,031 (87 per cent) was requested by and paid to State and interstate agencies which qualified for these grants. By the end of December 1957 all of the 59 eligible water pollution control agencies except the Virgin Islands Department of Health and the Bi-State Development Agency had requested and received grants for the first half of fiscal year 1958, totalling $1,585,628. Since unused allotments for the first half of any fiscal year are added to the total fund available for the second half, and are reallotted among the entire group of eligible agencies, it is anticipated that by June 30, 1958, about 95 per cent of the $3 million appropriation for 1958 will have been utilized. In FY 1957 all eligible agencies except the Nebraska Health Department and the Bi-State Development Agency requested and received funds, utilizing 93 per cent of the $2 million 1957 appropriation.

THREE-TON locomotives (left) handle 10 to 15 cars of rock load per trip. Batteries are charged (right) at shaft edge where lids are left open to dissipate the gases and heat formed during charging. Thus are sewer tunneling operations speeded on Pittsburgh Projects by . . .

Battery-Powered Locomotives

by ROBERT W. HOPEWELL, Manager,
Field Engineering, Gould-National Batteries, Trenton, N. J.

NO. 45 SHAFT, at Jacks Run Road, just outside of Pittsburgh, Pa., is a small but important segment of the unique $100 million trunk sewer and treatment project under construction by the Allegheny County Sanitary Authority. Adjoining the Ohio River, this 65-foot vertical access shaft is an integral part of the Ohio River intercepter system under contract by Mole Constructors Inc., Rankin, Pa. This riverside excavation, tunneled through water-bearing shale, clay, and rock, requires steel-rib lagging over the better part of its length.

A key tool of Mole Constructors' tunneling operations at shaft 45 and other segments of the 6-mile sewer project is a fleet of 12 battery-powered locomotives that shuttle rock and earth from the working face to the access shaft for removal. At the Jacks Run Road site Mole has a trio of 3-ton locomotives operating 24 hours per day on a three-shift basis to maintain their current advancement rate of 180 feet per week.

To keep these locomotives operating at peak capacity, two batteries per locomotive are maintained at the job site. One of the 40-cell batteries assigned to each locomotive is on charge at the surface while the second 40-cell battery is in use towing 10 to 15 cars in one of the two tunnels extending east and west from the shaft. At the end of the second shift, battery and case are hoisted to the surface and replaced with a fully-charged unit.

Batteries, locomotives and loaded cars are hoisted to the surface with a 20-ton portable crane. A sound-powered telephone and bell unit are used to direct the hoist operator.

On the surface, a maintenance mechanic checks the specific gravity of a pilot cell. Ampere-hour meters are mounted at one end of the battery case. As suggested by field engineers of Gould-National Batteries, the battery case lids are left open during the charging cycle so that batteries have an opportunity to cool off and the possibility of trapped gases, formed while charging, will be kept to a minimum.

Although the batteries are charged in the open, the charging equipment is housed in a wooden structure adjoining the shaft elevator and pumping station. The Gould 40-cell Super Dreadnaught batteries are charged by motor-generator units that automatically terminate the charge when the battery reaches full charge. Signal lights on panels of the units indicate whether the battery is on charge or not, and heavy-duty charging cables run from the charging room to the batteries at the shaft's edge. Current is bought at the job site from the municipal power company.

Charging procedure follows the standard two-rate pattern with automatic termination of charge when the battery is fully charged. An equalizing charge is periodically administered, depending on the recommendations of the Gould service engineers.

Although formal records of battery condition and charging data are kept to a minimum, batteries are inspected daily, water is added when necessary, and they are washed periodically with a solution of soda and water.

Because permanent battery repair facilities would be uneconomical at the job site of this fast-moving project, Mole maintenance engineers utilize the service facilities of the nearby Pittsburgh Gould service station for any repairs on batteries accidentally damaged in service.

High rate anaerobic sludge decomposition may be accomplished by . . .

DIGESTION CONTROL *with gas diffusion*

by PHILIP F. MORGAN, Prof. of Sanitary Engineering, State University of Iowa, Iowa City, Iowa, and PETER J. NEUSPIEL, Engineer, Chicago Pump Co., Chicago, Ill.

SUMMARY: In high-rate sewage sludge digestion systems the biological phase is carried on separately from the concentration phase, and the entire contents of the biological unit are intimately and continuously mixed.

In a normally operating digester, with gas diffusion, gas production rates follow a characteristic pattern after each sludge addition; a peak rate of gas production is achieved 3 to 4 hr after feeding and a return to the prefeed production rates occurs in 12 hr or less. Volatile acid concentration of the digesting sludge follows a pattern similar to the gas production rates.

For high-rate digestion the important environment controls are (a) continuous solids loading (obtained by regular pumping of sludge from primary tanks), (b) uniform temperature control (obtained by proper operation of external heat exchangers), and (c) uniform distribution of raw and digesting sludge in the biological unit (obtained by gas diffusion).

Operation stability is demonstrated by both gas production rates and volatile acid concentration in the biological unit. Digestion efficiency can be measured by a material balance survey of the biological phase, or by a sampling technique based on knowledge of the source of the digester solids content at any one time and a digester inventory at the end of the sampling period.

P. F. Morgan

■ HIGH-RATE DIGESTION of sewage sludge has attracted the attention of sanitary engineers during the past several years because it offers an opportunity for savings in new construction and for increasing the capacity of existing overloaded units. The use of high-rate digestion has made clear the relative importance of the two basic phases of treatment involved in digestion; that is, the biological phase, during which biochemical changes occur and the sludge is stabilized, and the mechanical phase, during which the volume of the sludge is reduced by withdrawal of supernatant liquor either before or after digestion.

These two phases are distinctly separate in high-rate systems, so that an optimum environment for biological life can be maintained during the biological phase and quiescent conditions for most effective gravity separation can be provided for in the mechanical phase. Two high-rate systems have been proposed for digesting sewage sludge.[1] One is based on the work in Iowa City where optimum conditions are maintained in the biological phase by recirculation of digester gas through diffusers located at the bottom center of the tank so the entire tank contents are kept in circulation.

This provides for control of the interaction of the gas and digesting sludge with the raw sludge added, prevents the formation of surface scum, and provides a means for removal of deposited sand. Supernatant liquor can be separated either before or after digestion, or can be disposed of with the digested sludge without separate sedimentation units.

In the other system, based on the work of Torpey,[2] optimum conditions are maintained in the biological phase by providing mechanical mixing, and only pre-concentrated sludge is used to provide a relatively high concentration of sludge in the digester. Normal digestion temperatures of approximately 35°C are used in both systems.

The research studies carried on at Iowa City during the past several years have been largely concerned with determining the optimum conditions for the biological phase and in establishing a relationship between laboratory bottle studies and pilot plant operations which can be used to project from the pilot plant to full-scale installations.

In the original work[1] with a 1,130-gallon pilot plant with gas recirculation, successful operation was main-

Ed. Note: At the time of this study, Mr. Neuspiel was a Research Associate at State University of Iowa. This paper was presented at the 2nd Waste Treatment Conference at Manhattan College and is published here by permission.

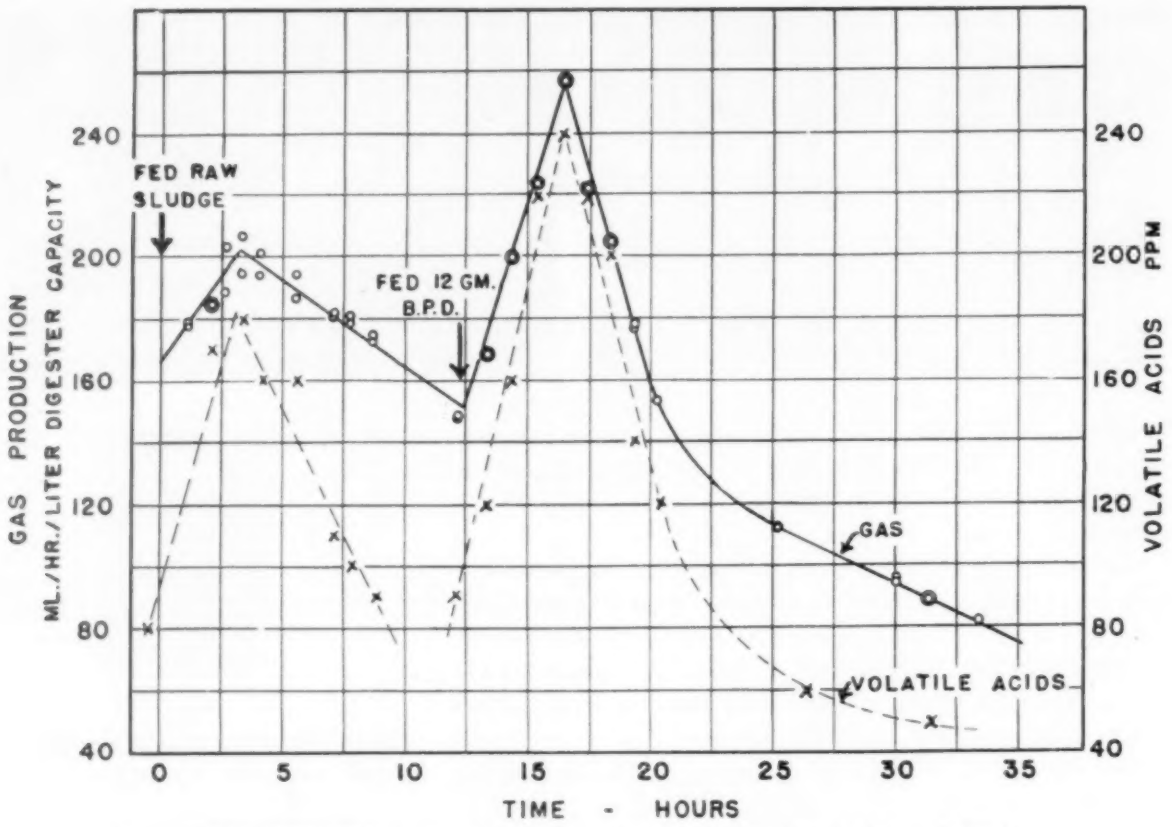


Fig. 1—GAS PRODUCTION rate and volatile acids concentration have definite relationship.

tained over a 10-month study period with an average loading of 0.46 lb of total solids per cubic foot per day and 0.28 lb of volatile solids per cubic foot per day at an average displacement period of 8.7 days with a gas production rate of 8.85 cubic feet per pound of volatile solids added.

Laboratory studies carried on in 8-liter bottles in parallel with the pilot plant indicated that tanks with gas circulation were more effective than tanks without gas circulation even though the gas rates used for these early studies were considerably less than the relative rate in the pilot plant. These studies also demonstrated that the results from the bottle studies were comparable to those from the pilot plant. Further investigation could then be continued on the bottles, where environmental conditions could be more easily controlled.

Sawyer and Schmidt,[3] and later Sawyer and Roy,[4] completed a series of laboratory studies on high-rate digestion. They confirmed that digestion could be successfully carried on at loadings characteristic of the high-rate system. In their first studies they mixed the digesting solids at regular intervals by manual shaking, but in the later studies they adopted a small gas pump for continuously recirculating gas to each bottle digester. Their results indicate that with gas mixing the loadings were comparable to the Iowa City results where a combination of manual mixing and manual gas recirculation had been used. They concluded that digestion periods as short as 10 days were practical without significant sacrifice of gas production or degradation of sludge quality.

Operating results from full-scale installations such as those at Columbus, Ohio,[5] and Moorhead, Minn.,[6] as well as observed results from several other installations where gas recirculation has been utilized, have confirmed the results of the bottle and pilot plant studies and the effectiveness of the process for digesting sewage sludge.

Continued progress undoubtedly will result in improved control methods, which will make possible higher design loadings and consequent savings in construction costs. Further research is needed to determine the minimum digestion time for varying environmental conditions. To try to accomplish this, work has been continued to obtain further information on (a) gas production rates in relation to raw sludge additions, (b) the effect of environmental control on digestion rates, and (c) better measurement of the performance of the digestion phase.

Gas Production Rates

It has been shown[7] that after each feed addition gas production and volatile acid production follow a predictable pattern (Fig. 1). The digester under study had an operating volume of 7,500 ml; digested sludge was withdrawn once a day and raw sludge was fed twice a day at a rate which provided a 10-day displacement. On the day preceding that on which the data for Figure 1 were obtained, the digester loading was 0.34 lb of volatile solids per cubic foot per day. At zero time a half-day's feed was added, which provided 0.17 lb of volatile solids per cubic foot per half-day. Gas produc-

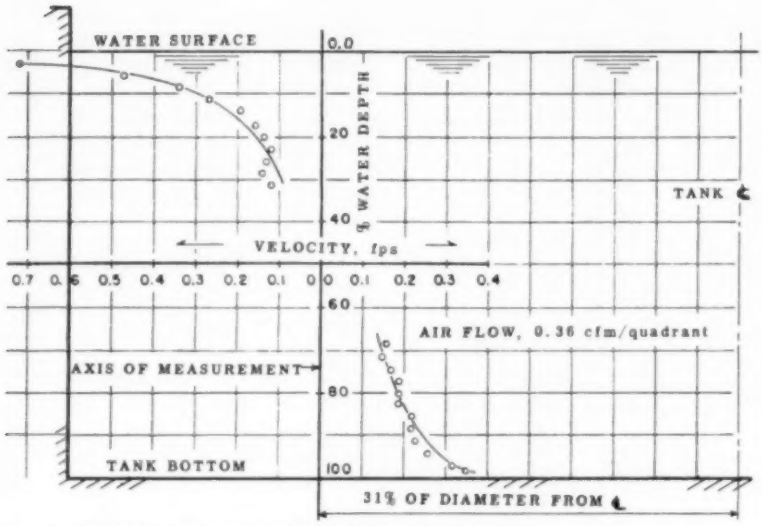


Fig. 2—TYPICAL vertical velocity profile in circulating tank.

tion rates and volatile acid concentration were determined at frequent intervals thereafter for 12 hr. At the end of this period a synthetic sludge composed of B.P.D. (bacto beef, bacto peptone and bacto dextrose 3:5:5 by weight) in a water solution was added at a loading rate of 0.10 lb per cubic foot per half-day and observations of gas production rates and volatile acid concentration were continued for 33 hours.

These results clearly demonstrate that gas is rapidly evolved after the addition of fresh sludge and that a characteristic peak production rate occurs 3 to 5 hr after sludge addition.

Following the peak production, the rate drops off on a straight line to one-half or three-quarters of the peak rate and then gradually further decreases to zero. Gas production from the synthetic sludge followed a similar pattern up to the peak rate and drop off, except that at the end of the 12 hr its rate was reduced to the base rate as if no synthetic sludge had been added, thus indicating that it was completely converted in 12 hr. It would appear from these results that when the environment can be controlled, anaerobic digestion is an exceedingly rapid phenomenon.

Because the pattern of the volatile acid data is similar, a close correlation between volatile acid production and gas production under conditions of normal operation is indicated. The volatile acid procedure used was a slight modification of "Volatile Acids in Digesting Sludge," as listed under the tentative tests in Standard Methods.[8] In the modification the 50-ml sample is centrifuged to remove all sludge solids and the distilling flask is protected with an asbestos ring to prevent superheating the glass above the liquid level.

Environmental Control

Similar operating results can be obtained in the full-scale installations only if a similar environmental control can be maintained in the full-scale tank. The most important factors of control appear to be solids loading, temperature control, and uniformity of distribution of sludge in the biological phase of the digestion process. If sludge is pumped so that it is transferred to the digester at substantially the same rate at which it arrives at the plant in the raw sewage, adequate control usually is provided. Wide variations in sludge volume often encountered may occur more because of inert material flushed down the sewers during wet weather flow than because of an actual variation of volatile material.

With modern external heat exchangers the control of temperature is not a problem as long as the entire tank contents are in circulation and therefore subject to the heating cycle.

Laboratory studies to demonstrate the uniformity of circulation of the digester contents have been carried out in a tank 4 ft square and 4 ft deep with one corner baffled so the tank was effectively one-quarter of a round tank having a 4-ft radius. Gas (actually air for this experiment) was discharged at various depths in the corner which represented the center of a full tank. Both the water depths and the depths of submergence of the point of diffusion were varied, and the horizontal circulating velocities were measured with a calibrated pygmy current meter. Vertical velocities were determined by observing the time of ascent of colored bubbles of carbon tetrachloride-benzene liquid adjusted to the specific gravity of the water. The velocity distribution is shown in Fig. 2. From the data[9] it is apparent that in a tank having a depth of 44 per cent of the diameter the top and bottom velocities are substantially equal. For example, the velocity at the 90 per cent depth is 83 per cent of the velocity at the 10 per cent depth, but in the opposite direction. At the 80 per cent depth the velocity is 120 per cent of the 20 per cent depth. Similar data were obtained for other depth-diameter ratios.

From the results of this study it was concluded that for tanks of the proportion under study the relationship between the quantity of gas diffused at the bottom center and the circulating velocities could be expressed by

$$Q = K\,V^3\,D \ldots (1)$$

in which Q is gas discharge, K is a proportionality factor, V is a representative velocity, and D is the diameter which was taken as the representative length.

Most of the velocity measurements for this study were taken at a point $D/3$ from the center and 5 per cent of the depth below the surface. Values of K were determined for both model and field conditions, which indicated that K increases with size, probably because of a decrease in importance of boundary shear with increase in size of tank. A K-value of 3.5 to 4.0 appears to give satisfactory results for conventional-size field installations.

Field confirmation of the effectiveness of circulation induced by gas lift was obtained by sampling at various depths at the Moorhead, Minn., and at the Alexandria, Minn., tanks. The solids concentrations are shown in Fig. 3 and it is apparent that except for the volume immediately below the diffusers, the entire tank contents are in circulation. Subsequent experience at these installations and at others has indicated that where sand is present it is deposited directly below the tubes. At this point it can be removed at

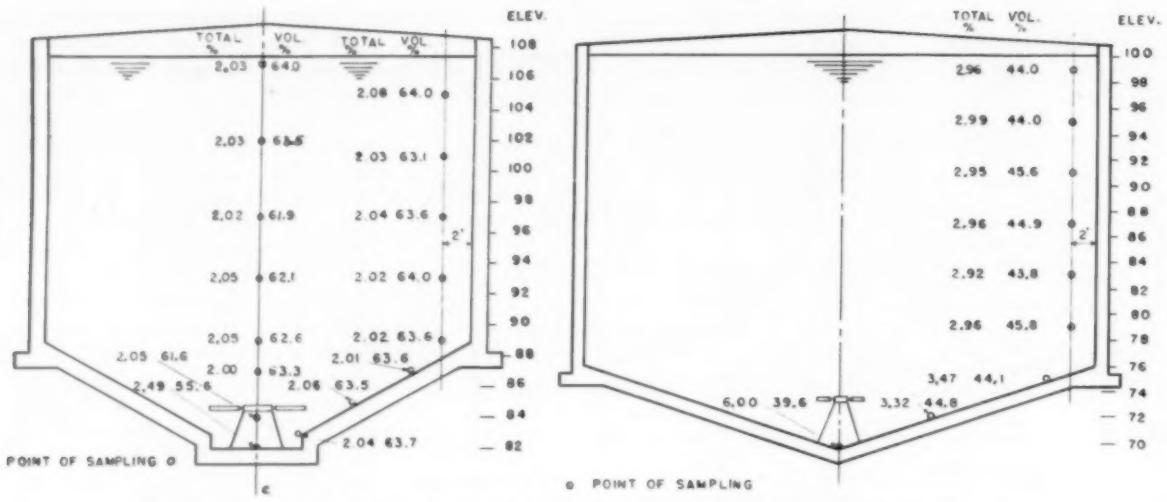


Fig. 3—SOLIDS distribution in digesters at Alexandria (left) and Moorhead (right) Minn.

regular intervals by gravity drainage. If not removed regularly it may accumulate in objectionable quantities, so its removal is a regular operating procedure.

The possible effect of the gas as an environmental factor other than mixing was indicated in the earlier studies[1] but was not further investigated then. Studies designed to demonstrate this effect are in progress.

Performance

Even though the solids loading and temperature are satisfactorily controlled and the digesting sludge is uniformly distributed throughout the tank, it is still necessary to have a measurement of performance to prove that the biological phase of digestion is accomplishing its purpose.

Performance can be measured both by the quantity and the quality of the final products (the gas and the digested sludge) and by environmental conditions of pH and volatile acids. From the standpoint of control of the digestion process, volatile acid concentration in the digesting sludge and gas production in cubic feet of gas pound of volatile solids added are of most interest. With uniform distribution of the solids throughout the digester these control tests have more meaning than in stratified tanks because the acid concentration represents the entire contents of the tank and not one zone where the sample was taken, and gas production reflects more directly the conversion rates of solids recently added. With digestion proceeding continuously there is no accumulation of undigested scum or pockets of undigested raw sludge which may remain dormant for some time and later undergo digestion with resulting gas production rates which are unrelated to raw sludge just previously added.

A recording gas meter is being provided for the Iowa City digester, which is being converted to allow gas diffusion, so that the rate of gas production as well as total production may be recorded. This will provide a continuous record that can be compared with the raw sludge added during each of the six daily pumping periods to give the operator an immediate indication of any change of production rates.

Determination of the volatile acid concentration in the digestion sludge serves as a check on conditions of digestion and, more important, as a check on gas production data. The laboratory and pilot plant results indicate that a major increase in volatile acids (over 1,000 ppm) is always accompanied by a reduction of gas production; likewise, a reduction in gas production is accompanied by a rise in volatile acids. Thus, the operator has available a double check on digestion conditions. A deviation of one factor is cause for investigating the technique of the laboratory procedure for the volatile acid determination or the accuracy of the gas metering equipment.

Although pH generally follows variations in volatile acid concentration, it does not provide as reliable a check on gas production because of the variations of availability of the free acid and the small variations between normal and abnormal operation on the pH scale.

Use of the volatile solids content as an index of the completion of digestion is of no value alone, but the comparison of the volatile content of raw and digested sludge to get the percentage reduction is often used because it provides the most direct measurement of the quality of the final product, the digested sludge. Such an index is of value only if it truly represents the change of the sludge passing through the digester.

One method of assuring realistic data is to complete a material balance survey of the digester, including an inventory of the digester contents at the start and at the end of the test period. The input data will consist of the total wet weight, the total solids, and the volatile solids in the raw sludge and in the digester at the start of the study. The output will include similar data for the digested sludge, the supernatant liquor (if there is any) and the digester contents at the end of the test period, plus the gas produced. The period of study for such a material balance survey should be long enough so that the tank contents are displaced at least once. A longer period is preferable.

Neuspiel[10] has proposed another method of obtaining realistic data on solids reduction in anaerobic biological units where the entire tank contents

are homogeneous. He has shown that in a homogeneous tank with a fixed volume and with regular and continuous solids additions, the contents at any given instant are from known solids previously added. Sixty-three per cent of the tank contents are from sludge added during the last displacement period, 23 per cent are from sludge added during the next preceding displacement period, 9 per cent are from the next preceding period, etc. Thus, 95 per cent of the entire tank contents are from the previous three displacement periods. So that the solids reduction may be computed, loading is determined for three displacement periods; the average loading is weighted according to the 9, 23 and 63 per cent proportions in the tank. A tank inventory is completed at the end of the third displacement period and the solids destroyed are simply the difference between the weighted average loading, corrected to 100 per cent and the contents at the time of the survey. Where it can be utilized, this is far simpler than the material balance survey.

Acknowledgment

The work reported herein was supported by the Chicago Pump Company and was carried on at the Iowa City sewage treatment plant. Patents assigned cover the control of the introduction of the digester gas into the body of the sludge undergoing digestion and the proper control of the interaction of the gas with the sludge.

References

1. Morgan, Philip F., "Studies of Accelerated Digestion of Sewage Sludge." *Sew. and Indus. Wastes, 26,* 4, 462 (1954).
2. Torpey, Wilbur N., "High-Rate Digestion of Concentrated Primary and Activated Sludge." *Sew. and Indus. Wastes 26,* 4, 479 (1954).
3. Sawyer, C. N., and Schmidt, Harold E., "High-Rate Digestion." *Jour. Boston Soc. Civil Eng.* (Jan. 1955).
4. Sawyer, C. N., and Roy, H. K., "A Laboratory Evalution of High-Rate Sludge Digestion." *Sew. and Indus. Wastes, 27,* 12, 1356 (1955).
5. Blodgett, J. H., "Accelerated Digestion Successful at Columbus, Ohio." *Wastes Eng., 24,* 608 (1955).
6. Morgan, Philip F., "Accelerated Sludge Digestion by Gas Diffusion." 2nd. Ann. Continuation Course in Waste Engineering, Univ. of Minnesota, pp. 22 (Dec. 14, 1955).
7. Morgan, Philip F., "Efficient Utilization of Digester Capacity." *Sew. and Indus. Wastes, 26,* 11, 1340 (1954).
8. "Standard Methods for the Examination of Water, Sewage and Industrial Wastes." 10th Ed., Amer. Pub. Health Assn., New York, N. Y. (1955).
9. Morgan, Philip F., and McNown, John S., "Report on Model Studies of Circulating Velocities Induced in Cylindrical Tanks by Gas Lift." A report to Chicago Pump Co. (Dec. 31, 1951).
10. Neuspiel, Peter J., "Sampling Procedure for Tanks of Homogeneous Content." *Sew. and Indus. Wastes, 29,* 12, 1347 (1957).

Sidelights on Ancient Egyptian Sewerage and Water Supply

The sanitation and sewerage engineer in the days of the Pharaohs seemingly were bowel specialists, as well as consultants on the disposal of excreta. Some of them were actually called "bowel surveyors", others "shepherds of the anus" etc. They concerned themselves with the egrestive faculty, practiced giving enemas and supervised the use of clysters and purges. Indeed, the proficient "bowel surveyor" was the most important official in the royal court.

One of these specialists lies in just repose in the empire cemetery near the great pyramid of Gizah in a select tomb which dates circa 2600 B.C. It was he who devised a cesspool kept filled with water brought in through a built culvert from the Nile, which rose a fell in its water level with the river. In this we had the premier self cleaning septic tank. We know not how Pharaoh's lavatory and bath was connected with this sewerage system, but we are told that sweet oil kept down the odor.

We also have some evidence of a latrine equipped with running water, used by royalty and ladies of rank, located in scent chambers. The inverts of the 'running through' latrines were of no less than hollowed marble with a seat rail of polished cedar wood.

The ancient Eyptians made water pipes of beaten copper. These were laid in sections in rock trenches and covered with gypsum, as in the Temple of King Sa-hi-Re at Abusir dating about 2750 B.C. In another case a pipe was made of cedar wood and lined with lead, the lead being bedded in bitumen. These are highlights of sewerage and water supply in the dim and distant days of cultured Egyptians.

*A contribution from Colin J. Robb, Ballynahinch, Ireland.

Availability of Water

If you are interested in the "Availability of Water in the United States with Special References to Industrial Needs by 1980," write to Walter L. Picton, Deputy Director, Water and Sewerage Industry and Utilities Division, Business and Defense Services Administration, Dept. of Commerce, Washington, D. C.

This is a 74 page bulletin prepared by D. R. Woodward, as Thesis No. 143, in the resident course of the Industrial College of the Armed Services. The main divisions of the bulletin are Introduction, Available Supply, Current Use of Water, Estimated Future Use of Water, Comparison of Demand and Supply, Special Problems, Summary and Conclusions.

In brief the report shows that the gross water resource of the U. S. is about 1,164 gal per day, but it is not uniformly distributed as to time or geographic area. No major change in gross water resource is likely by 1980. Present reliable and dependable supply is 314 bil gal per day. The 1955 uses totaled about 221 bil gal per day.

Water use by 1980 is expected to be 600 bil gal per day and dependable supplies will increase to 500 bil gal per day as a result of increased storage. Desalting of sea water may alter both the gross and dependable water supplies.

The author concludes that competition for dependable water supply will increase; there is a need for understanding of the nature and limitation of water resources; there is a pressing need for adequate and intelligent public administration of the nation's water resources at all levels of government; and the relative importance and value of the several uses of water needs better definition in order to be objective about choices in use.

Well Water Turns Whisky Black

Lynn M. Thatcher, chief of the Utah State Health Dept., bureau of sanitation, was recently confronted with a complaint from a woman that when water from the family well was added to her husband's whisky, the drink turned black and looked like crankcase drippings.

The bureau of sanitation analyzed the bacterial content of the well water, but Mr. Thatcher does not feel that the bureau's authority extends to seeking a chemical answer to the black whisky mystery.

The editor's comments

The Report Is Exaggerated

Recently we received a letter from a subscriber renewing his subscription. One paragraph in his letter both pleased and intrigued us. "Congratulations to Dr. George E. Symons, the new Editor. Last week an equipment salesmen was in and stated that *Water & Sewage Works* was going out of business which made me feel badly, as it has been a great help in our operation."

We appreciate the kind works of this reader, and we thank him for them. We can only wonder who was the misguided salesman who reported our imminent demise, and we wonder too, why he would make the statement. We'd like to remind him that as the Mark Twain character said, "The report of our death has been greatly exaggerated."

A Word On Policy

Speaking of letters to the Editor, not too long ago within two days I received two letters from subscribers. One letter, from a water works superintendent complained that *Water & Sewage Works* contained far more material on sewage disposal than it did on water supply. The other letter from a sewage works superintendent said, "*Water & Sewage Works* is written almost entirely for water works men and doesn't carry very much material on sewage disposal."

Two diametically opposed opinions; unfortunately both are incorrect.

As a matter of fact, it has always been the policy of *Water & Sewage Works* to carry reading material (articles, reports, etc.) divided between water supply and sewage disposal roughly in the ratio of the number of water plants to the number of sewage plants in this country or about two pages of articles on water to one page of articles on sewage. That ratio also represents the approximate division of interest of our readers, and it has been the goal in previous years. Perhaps that ideal has not always been met but the reason has been principally because of lack of good articles in either one branch or the other.

For the future, the goal will be 60 per cent of main reader pages devoted to water supply and 40 per cent to sewage disposal. If our readership interest changes, the ratio will be changed. From month to month this ratio may vary; for example, when the AWWA Convention is held, that issue will carry a preponderance of water supply articles; conversely the October issue will carry a preponderance of articles on sewage disposal. Over the year, however, I shall try to balance the book as indicated.

Another matter of editorial policy may be of interest. For many years in helping to program technical association meetings, I have believed that the technical representatives of manufacturers often have something of interest to say to the field and therefore should be welcomed to a place on the program. I do not believe that such persons should "hawk their wares" from the technical association platform, but their technical studies deserve recognition and presentation.

I feel the same way about articles in this magazine by representatives of manufacturers. I do not believe in insulting our readers with advertising "puffs" in the guise of a technical article, but I do believe that just because an article is written by a manufacturer's representive, or is about an installation of his equipment, is no reason to exclude it from publication.

The sole criteria on the acceptability of such articles is" Does it inform, will it add to our basic knowledge, and is it free of advertising plugs" Normally, I must admit that I am not anxious to publish several papers from one man or one organization in a single year, but technical excellence will be in the principal criteria of acceptance.

Wanted: An Article

A third letter to the Editor, received during the past few months said, "I did not intend to renew my subscription, but I am. I have learned many things from reading your magazine and enjoyed reading it. However, your magazine does not teach anything about Crooked Politics and no matter how much a man may know or how good in the water and sewage field he becomes, any loafer or drunk can have the water and sewer jobs, as long as he's OK, with the boys.

"I hope some day to see a story in your magazine about 'The effect of politics on the small town water and sewer dept.'"

I asked a man, from the state from which this letter came, about this situation, and he told this story: In one city following a change in administration the new water superintendent had been a barber until then, but his feet were playing out on him so he decided to try for the water works job; he got it.

This man may have been a good barber; he may even make a good water superintendent some day, but the idea is all wrong. This matter of making the water and sewer superintendents a political football is a deterrent to getting good men into the field, men who can do a good job for the public.

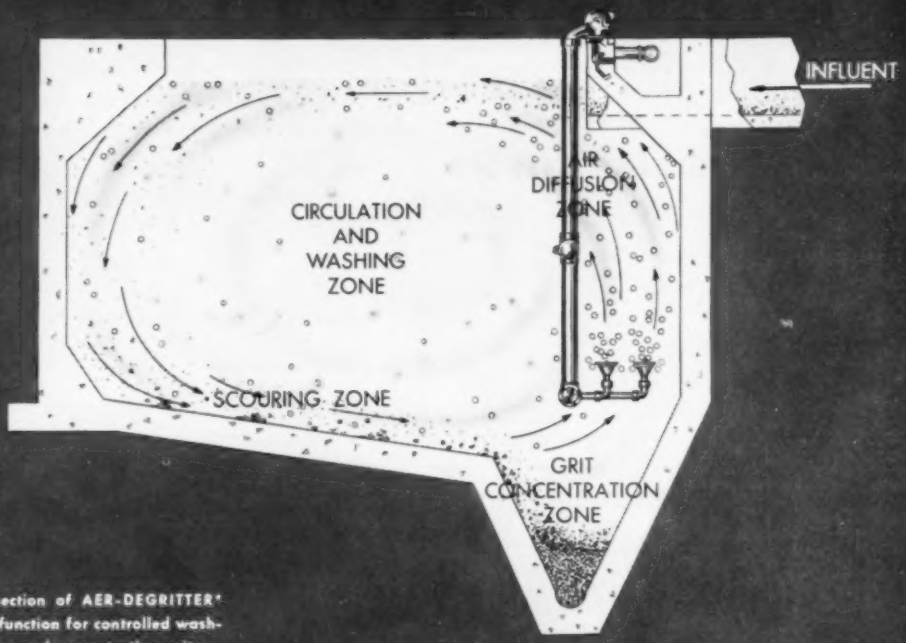
It seems to me that here is an area where OWWA (Operation Water Works Management) of AWWA can make a contribution to our industry, and I, for one, hope that it does.

George E. Symons.

"from Chicago"

The WHY and HOW of SUCCESSFUL AERATED GRIT REMOVAL

Through the *AER-DEGRITTER** Grit Removal System



Typical cross section of AER-DEGRITTER* showing basic function for controlled washing, transporting and concentrating grit.

EXCLUSIVELY SUCCESSFUL COMBINATION of tank design and air diffuser location provides simultaneous grit washing and concentration, based upon:

- ADEQUATE AIR DIFFUSION for controlled circulating velocities.
- CORRECT LOCATION OF AIR DIFFUSERS (unobstructed) directly over the hopper causes complete circulation of tank contents for grit washing and transporting across entire tank bottom into grit hopper. (Air diffusers in wrong location will "short circuit" bottom circulating velocities and cause uncontrolled grit and organic pile-up on tank bottom.)

  Grit removal from tank hopper by Chicago Pump Company Air Lift pumps, tubular conveyors, screw or bucket elevators, clam-shell buckets or other means depending on specific job needs.

The AER-DEGRITTER* Aerated grit removal system is provided with Chicago Pump Company Swing Diffuser aeration equipment and, depending on requirements, Precision or FLEXOFUSER® diffusion tubes or Discfuser air nozzles.

ONLY THE AER-DEGRITTER HAS A PROVEN RECORD OF SERVICE . . . OVER 150 INSTALLATIONS

*The application of the equipment, as well as the equipment itself is covered by U.S. Patents No. 2,532,457, No. 2,328,655, No. 2,555,201 and pending patent applications.

always specify "Chicago"

CHICAGO PUMP COMPANY

Sewage and Industrial Waste Equipment

Subsidiary of Food Machinery & Chemical Corporation

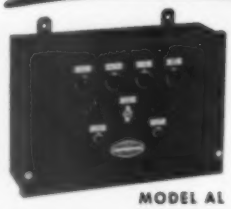
fmc

622 Diversey Parkway Chicago 14, Illinois

MADE FOR . . .

YOUR ENGINE'S

Protection



MODEL AL

Any abnormal condition existing in your engine can be immediately brought under control by the operator with the use of Synchro-Start . . . . . .

AUTOMATIC ENGINE CONTROLS

Your engine can be protected by being automatically shut down at the first sign of low oil pressure, high water temperature, overspeed, etc.

The AL series of Synchro-Start Controls is made to fit individual requirements. Your specifications sent to us will bring immediate response.

Write for detailed information

SYNCHRO-START PRODUCTS, INC.

Since 1932

8151 NORTH RIDGEWAY AVENUE • SKOKIE, ILLINOIS

PHOTOVOLT pH METER MODEL 85

A Full-Fledged Line-Operated pH Meter at $105.–

including set of electrodes; available also with combination electrode at $108.–

No batteries to replace

Simple in operation

Dependable in service

Full pH range 0-14
3" scale, readable to 0.1
Available with carrying case

Usable with all types of electrodes, swing-arm adapter, polarization adapter for Karl Fischer titrations, electrode extension cables, etc.

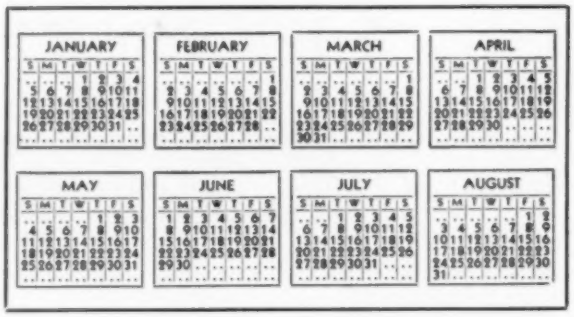
Write for Bull. 195

PHOTOVOLT CORP.

95 Madison Avenue New York 16, N. Y.

Meetings

1958



May 5-7—Lafayette, Ind. *(Purdue University)*
13TH PURDUE INDUSTRIAL WASTE CONFERENCE, Chairman, Prof. Don E. Bloodgood, Purdue University, Lafayette, Ind.

May 5-7—Lafayette, Ind. *(Purdue University)*
CENTRAL STATES SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Scott E. Linsley, P. O. Box 3598, St. Paul 1, Minn.

May 15—Brattleboro, Vermont
NEW ENGLAND WATER WORKS ASSN., Secy., Joseph C. Knox, 73 Tremont Street, Boston 8, Mass.

May 15-17—Spokane, Wash. *(Davenport Hotel)*
PACIFIC NORTHWEST SECTION, A.W.W.A., Secy., Fred D. Jones, Asst. Supt., Water Dept., 306 City Hall, Spokane, Wash.

May 15-17—Tucson, Ariz. *(El Conquistador Guest Hotel)*
ARIZONA SECTION, A.W.W.A., and ARIZONA SEWAGE & WATER WORKS ASSN., Joint Meeting, Secy., Stanford I. Roth, 813 E. Jefferson, Phoenix, Ariz.

May 16-17—Mt. Horeb, Wisconsin
CONF. OF WISCONSIN SEWERAGE WORKS OPERATORS, Spring Meeting, Secy., Charles A. Kelley, 312 Randall Pl., Elkhorn, Wis.

May 18-24—San Juan, Porto Rico
6TH CONGRESS OF INTER-AMERICAN ASSN. OF SANITARY ENGINEERING, Secy.-Gen., Enrique Ortega, Apartado 218, San Juan 2, P. R.

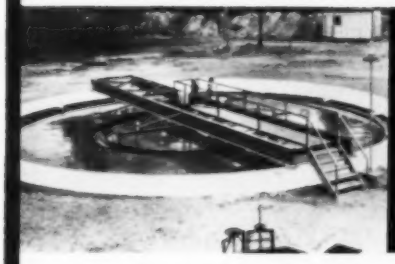
May 25-28—Honey Harbour, Ontario, Canada *(Delawana Inn)*
FIFTH INDUSTRIAL WASTE CONFERENCE, Secy., D. S. Caverly, Ontario Water Resources Comm., East Block Parliament Bldgs., Toronto 2, Canada

May 26-27—Catskills, N. Y. *(Grossinger Hotel)*
NEW YORK SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Ralph C. Sweeney, c/o State Dept. of Health, 55 Church St., White Plains, N. Y.

June 2-4—Toronto, Canada *(Royal York Hotel)*
CANADIAN SECTION, A.W.W.A., Secy., A. F. Berry, Ontario Water Resources, Parliament Buildings, Toronto, Ontario, Can.

YEOMANS MANUFACTURES THE MOST COMPLETE LINE OF APPLICATION-DESIGNED SEWAGE TREATMENT EQUIPMENT

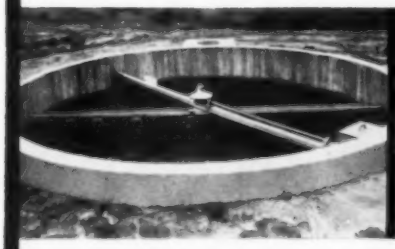
which includes..



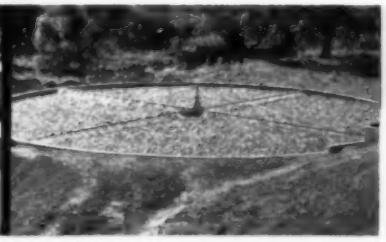
. . SPIRAFLO CLARIFIER for both primary and final clarification of domestic and process wastes. A clarifier of radically different design, the Spiraflo offers complete settleable solids removal; greater removal of finely divided particles; positive grease, scum oil removal; uniform velocity throughout tank; and straight wall design which reduces construction costs.

. . the HI-CONE, the most important development in the surface aeration process of activated sludge treatment in the last 30 years. The Hi-Cone offers much greater circulation, and can handle substantially more sewage with no increase in power consumption per MG treated. Maintenance costs are minimized because nothing can clog.

. . the CAVITATOR, a newly developed Yeomans unit for low cost treatment of both domestic sewage and industrial wastes. Perfectly suited for small communities, subdivisions, motels, resorts, schools and industrial plants, the Cavitator has excellent purification efficiency, extremely high oxygen transfer efficiency, and extremely low air requirements per pound of B.O.D. removed.



. . the WATER-WHEEL, a rotary distributor used with trickling filter systems in the secondary treatment of sewage. An exceptionally rugged, yet simple piece of equipment, the Water-wheel provides uniform distribution over the entire filter bed at all flow rates . . even the lowest. Costly accessories, such as underground feed pipe, dosing chamber with siphon, center support, and mercury seal, are not required.



. . YEOMANS ROTARY DISTRIBUTORS (both standard rate and high capacity). Standard rate units distribute evenly across the entire filter bed . . adjustable nozzles produce fine, well-aerated spray which carries down high volumes of oxygen. For high capacity filters, both the Yeomans high capacity type distributor and the Aero-Filter system are available.

YEOMANS

1999-9 N. RUBY STREET
MELROSE PARK, ILL.

manufacturers of:

distributors • clarifiers

mechanical aerators

pneumatic sewage ejectors

digesters • centrifugal pumps

Use this coupon to request any or all of the following technical bulletins:

- ☐ Yeomans Spiraflo Clarifier, bulletin 6791
- ☐ the Hi-Cone, manual 6000 . . also 12-page brochure, "it's a matter of public record"
- ☐ the Cavitator, 12-page booklet
- ☐ Water-wheel, catalog 6555
- ☐ Yeomans Rotary Distributors, bulletin 6504 . . also manual 6000

name _____

company _____

street _____

city _____ *zone* _____ *state* _____

Mail to: YEOMANS, 1999-9 N. Ruby Street, Melrose Park, Illinois

June 4-5—Gardner, Mass. *(Colonial Hotel)*
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Earl R. Howard, 115 Broad St., Hartford 5, Conn.

June 4-6—Auburn, Ala. *(Ala. Polytechnic Institute)*
ANNUAL SHORT COURSE SCHOOL AND MEETING ALABAMA WATER & SEWAGE ASSN., Secy., E. J. Finnell, Univ. of Alabama, University, Ala.

June 9-11—Auburn, Ala. *(Ala. Poly. Inst.)*
ALABAMA WATER & SEWAGE ASSN., Short Course, Secy., Prof. Robert T. Tindal, University of Ala., University, Ala.

June 12—Belfast, Maine
MAINE WATER UTILITIES ASSN., Secy., Gerard F. Laurin, 89 Western Ave., Augusta, Maine

June 12-13—Frederick, Md. *(Francis Scott Key Hotel)*
MARYLAND-DELAWARE WATER & SEWAGE ASSN., Secy., W. M. Bingley, 2411 N. Charles St., Baltimore 18, Md.

June 18—Swampscott, Mass. *(New Ocean House)*
NEW ENGLAND WATER WORKS ASSN., Secy., Joseph C. Knox, 73 Tremont Street, Boston 8, Mass.

June 18-20—Toledo, Ohio *(Commodore Perry Hotel)*
OHIO SEWAGE & INDUSTRIAL WASTES TREATMENT CONFERENCE, Secy., Cleamon E. Lay, 301 Ohio Departments Bldg., Columbus 15, Ohio

June 18-20—Council Bluffs, Iowa *(Hotel Chieftain)*
IOWA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., L. F. Skorczeski, 207 South 15th Ave., Marshalltown, Iowa

June 22-25—Philadelphia, Pa. *(Bellevue-Stratford Hotel)*
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, 50th Anniversary Meeting, Secy., F. J. Van Antwerpen, 25 W. 45th St., New York 36, N. Y.

June 23-25—Charlevoix, Mich. *(Charlevoix Beach Hotel)*
MICHIGAN SEWAGE & INDUSTRIAL WASTES ASSN., Secy., Donald M. Pierce, Michigan Dept. of Health, Lansing 4, Mich.

June 23-27—Portland, Oregon *(Hotel Multnomah)*
AMERICAN SOCIETY OF CIVIL ENGINEERS, Exec. Secy., W. H. Wisely, 33 W. 39th St., New York 18, N. Y.

June 25-27—Erie, Pa. *(Hotel Lawrence)*
PENNSYLVANIA SECTION, A.W.W.A., Secy., L. S. Morgan, Div. Engr. State Dept. of Health, Greensburg, Pa.

Aug. 11-13—University Park *(Pa. University)*
PENNSYLVANIA WATER WORKS OPERATORS' ASSN., Secy., Harry A. DeWire, 29 Chestnut St., Lewistown, Pa.

Aug. 13-15—University Park, Pa. *(Pa. University)*
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSN., Secy., J. R. Harvey, 916 Diamond, Meadville, Pa.

Aug. 14—Millinocket, Maine
MAINE WATER UTILITIES ASSN., Secy., Gerard F. Laurin, 89 Western Ave., Augusta, Maine

Sept. 8-10—Grand Rapids, Mich. *(Pantlind Hotel)*
MICHIGAN SECTION, A.W.W.A., Secy., T. L. Vander Valde, Chief, Michigan Dept. of Health, DeWitt Rd., Lansing 4, Mich.

Sept. 10-12—Lake Placid, N. Y. *(Lake Placid Club)*
NEW YORK SECTION, A.W.W.A., Secy., Kimball Blanchard, 19 West 50th St., New York 20, N. Y.

Sept. 14-17—Poland Spring, Maine *(Poland Spring House)*
NEW ENGLAND WATER WORKS ASSOCIATION, Secy., Joseph C. Knox, N.E.W.W.A., 73 Tremont St., Boston 8, Mass.

Sept. 17-19—Cleveland, Ohio *(Statler Hotel)*
OHIO SECTION, A.W.W.A., Secy., J. H. Bass, Robert F. McGivern & Assoc., 1771 West Fifth Ave., Columbus 12, Ohio.

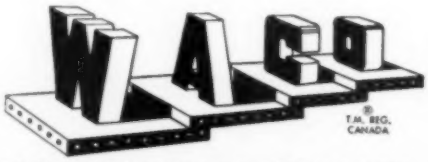
Sept. 17-19—Wausau, Wis. *(Hotel Wausau)*
WISCONSIN SECTION, A.W.W.A., Secy., Harry Breimeister, City Engineers Office, City Hall, Milwaukee 2.

Sept. 17-19—Deadwood, S. D. *(Franklin Hotel)*
SOUTH DAKOTA WATER & SEWAGE WORKS CONF., Secy., Don C. Kalda, Pierre, S. D.

Sept. 22-24—Memphis, Tenn. *(Peabody Hotel)*
KENTUCKY-TENNESSEE SECTION, A.W.W.A., Secy. J. Wiley Finney, Jr., Howard K. Bell, Cons. Engrs., 553 So. Limestone St., Lexington, Ky.

(Jointly With)

KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSN., Secy., S. Leary Jones, Cordell Hull Bldg., Nashville, Tenn.



ALUMINUM WALKWAYS ARE SAFE, MAINTENANCE-FREE

Non-Corrosive, Strong and Durable—They are Valuable Assets in Water and Sewage Plants

George H. Hill, Washington Aluminum's New England representative, points out the grating's patented perforation pattern.

Washington Aluminum Walkways ***provide*** a lifetime of maintenance-free service — never need painting, resist rust and corrosion, provide ventilation. Their strength lies in the I-beam extrusion.

Washington Aluminum fabricates grating and other installations to specification. Consult our Engineers at point of planning. . . . No charge — no obligation! . . . an engineering service of Washington Aluminum Company, Inc.

WASHINGTON ALUMINUM COMPANY, Inc.

Dept. 75 • Baltimore 29, Md. • Phone Circle 2-1000

"DIXIE'S NATIONWIDE SERVICE SATISFIES"

THE SILENT WATCHMAN

The largest water tank repair company in the United States is at your service. Repairs guaranteed for 12 years . . . interior paint guaranteed for 3 years . . . exterior painting guaranteed for 6 years.

Representatives in every state of the Union.

DIXIE TANK'S "SYMBOL" OF YOUR PROTECTION

DIXIE TANK & BRIDGE CO.

Please write or wire us for more information.

3523 LAMAR AVENUE

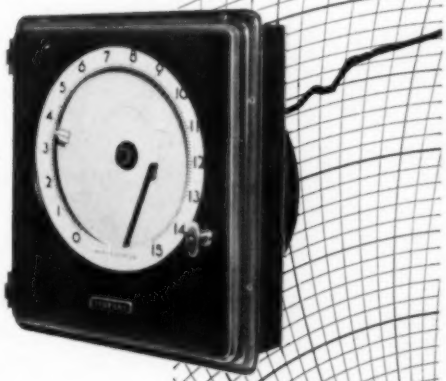
MAILING ADDRESS: P. O. BOX 14, MEMPHIS 1, TENN.

ACCURATE GRAPHIC AND VISUAL REGISTRATION

of liquid flow with

STEVENS

RECORDER TYPE B-FT



Recording, indicating and totalizing meter for measuring sewage or other flows over Parshall flumes and weirs. This instrument has interchangeable flow cams and flow conversion gears . . . an important factor to consider for sewage treatment plants in rapidly growing communities. With a simple change of cams and gears the Type B-FT Recorder can operate with a different size flume or accommodate a greater range of flow than that for which it was originally purchased. The change does not require factory service. Similarly, change from weekly to daily time scale, or vice versa, is accomplished by merely repositioning one gear — no new parts to buy.

This recorder can be direct float operated or remotely controlled and is available for wall or switchboard mounting, or with cabinet for mounting out of doors directly over the float well. Request BULLETIN 25 for complete details.

STEVENS DATA BOOK

Invaluable for your reference file. Contains technical data on recorder installations, plus a wealth of hydraulic and conversion tables. $1 copy. (No COD's)

STEVEN

C

DATE

TOTALIZER BEGIN

LEUPOLD & STEVENS INSTRUMENTS, INC.

4445 N. E. GLISAN STREET · PORTLAND 13, OREGON

Specialists in hydrologic instruments for over half a century.

Equipment News

CONTINUED FROM PAGE 19A

Gas Fired Boilers For Sewage Plants

518

The Peerless Heater Co., Boyertown, Pa., recently introduced a new line of high capacity Gas Fired Boilers known as the "series 150" rated from 600,000 to 5,400,000 B.T.U. input/Hr. The boiler with green enamel steel jacket contains a rugged cast iron base, easily removed cast iron burners and the "Peerless 13 water tube cast iron sections."

The new design makes the series 150 ideal for sewage disposal plant work due to large clean-out doors. At each end of the boiler making it unnecessary to remove jacket to clean flue ways, the "H" block designed boiler sections permit passage of cleaning brushes directly through the flue passages, allowing easy removal of deposits caused by excessive condensation.

With the added feature of easily removed cast iron burners accessible through the convenient front doors—complete cleaning of the entire boiler is possible with a minimum amount of time and effort.

safe water needs

Non-dusty, free-flowing dry chlorine for control of algae and bacteria in:

reservoirs • basins • tanks • flumes
pumps • supply equipment

HTH Granular contains 70% available chlorine. It is packed in 100-lb. lithographed steel drums and in cases of nine 5-lb. cans.

OLIN MATHIESON CHEMICAL CORPORATION
HTH
OLIN MATHIESON CHEMICAL CORPORATION
INDUSTRIAL CHEMICALS DIVISION • BALTIMORE 3, MD.
HTH® is a trademark

5536

Newly Designed Sewer Cleaner

519

Flexible, Inc., Los Angeles, California, has developed a new Truck-Loder Bucket Machine that eliminates hand shoveling and unsanitary sewer deposits on city streets.

The completely new design makes it possible to back up a truck directly under the dumping end of the machine. It is said that simplicity of

operation makes the Truck-Loder easier to operate than conventional Bucket Machines, so that deposits can be brought from sewer to truck in a matter of 60 seconds. Since a helper is no longer needed to dump the bucket or shovel deposits into the truck, cleaning with Bucket Machines is now a two man operation.

Submersible Pumps

520

The F. E. Meyers & Bro. Co., Ashland, Ohio, has announced production of a new line of six inch diameter submersible pumps.

The new line of heavy duty submersible units are particularly suitable for deep well installations where large volumes of water are needed. The pump can be installed in wells as deep as 700 feet. The line's top capacity at a 50 foot depth is over 13,000 gallons of water an hour.

The Myers "SC" submersible operates completely under water and is a combined pump and motor unit. The 60 cycle motor is oil lubricated, sealed, and drives the pump through

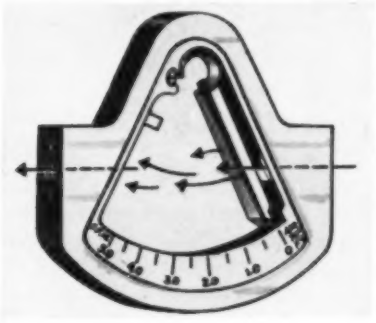
a rigid coupling. Power is supplied to the submerged motor by a waterproof cable that is attached to the riser column pipe. The pump is available in 5, 7½, 10 and 15 horse power sizes.

Indicating Flowmeters

521

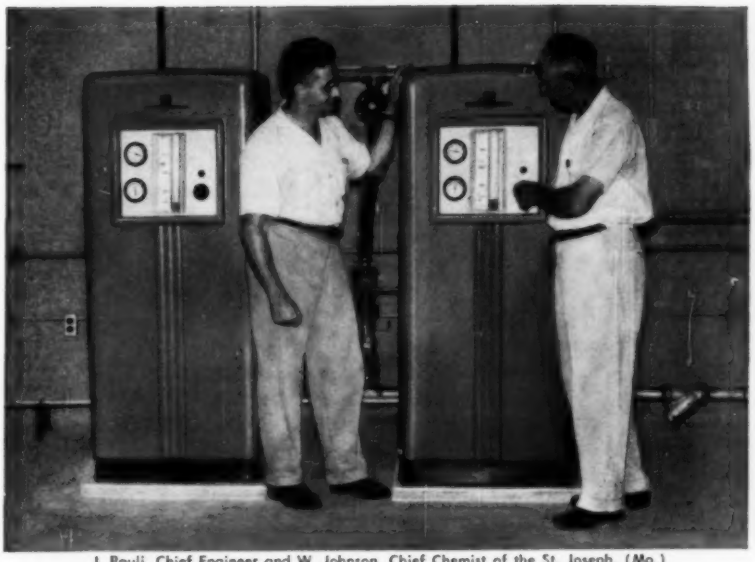
Seico Instrument Division, Eclipse Fuel Engineering Co., Rockford, Illinois, has recently enlarged and improved its line of indicating flowmeters for air, gases, and liquids.

Standard liquid flow instruments are now available with aluminum and brass bodies for pressures up to 2,000 psig, and with special body materials for corrosive applications. Scale ranges run from 0 to 6 gph (0 to 0.1 gpm) up to 0 to 6000 gph. For scale ranges up to 20 gpm, meters are available for direct installation in the flow lines. For larger scale ranges, shunt arrangements are used. All instruments are furnished complete ready to connect into the flow piping.



All of the instruments are hermetically sealed, can be installed in vertical or horizontal position and are said to be unaffected by vibrating conditions.

In operation a portion of the flow acts upon a movable vane. As the vane rotates with increase in flow, the amount of flow by-passing the vane increases, and, according to the manufacturer, the large area of vane engagement with the flow stream serves to average velocity differences and turbulence, providing approximation of the ideal of laminar flow. In the liquid flow instruments, the vane is the pointer and travels under a transparent plastic cover, permitting visual inspection of flow. In the gas flow instruments, the vane operates a gear-driven pointer.



J. Pauli, Chief Engineer and W. Johnson, Chief Chemist of the St. Joseph, (Mo.) Water Company, discuss operation of their W&T V-notch chlorinators. The St. Joseph Water Co. is part of the American Water Works Service Co., Inc. system.

W & T V-notch Chlorinators— doubly accepted

The St. Joseph Water Co. found breakpoint chlorination the best way to treat Missouri River water. But this increased the range of chlorine requirements in the water treatment. W&T V-notch chlorinators were the answer.

W&T V-notch chlorinators have a chlorine feed range of 20 to 1 with an accuracy of 4%. Based on this acceptance at its St. Joseph plant, the American Water Works Service Co., Inc. has purchased V-notch equipment for use in other plants.

V-notch chlorinators are available to feed from 2½ to 8000 pounds of chlorine per 24 hrs. V-notch equipment also provides permanence and attractiveness through modern reinforced plastics. For comprehensive information about W&T V-notch chlorinators, write for Bulletin S-122.

WALLACE & TIERNAN INCORPORATED
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

E. R. P. CATHODIC PROTECTION
...INDIVIDUALLY DESIGNED FOR EACH APPLICATION
to prevent corrosion of buried or submerged metal structures
Write for Bulletin E-37
E-37

ELECTRO RUST-PROOFING CORPORATION
30 MAIN STREET, BELLEVILLE 9, N. J.

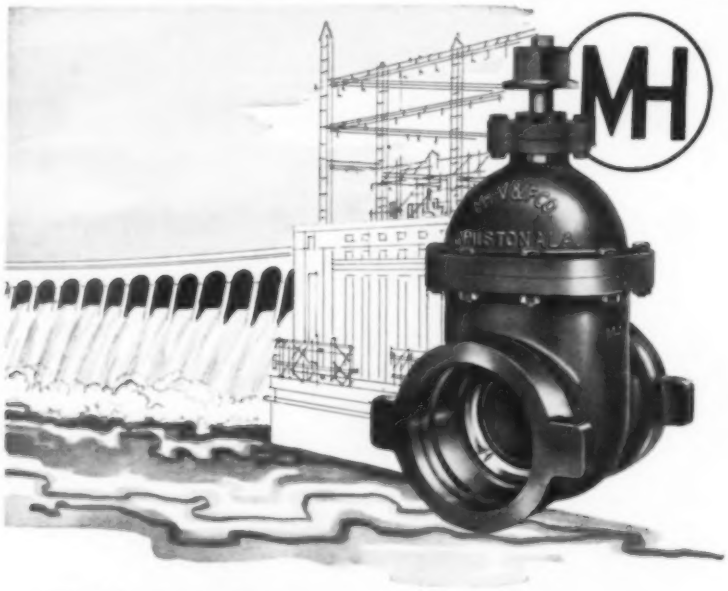
News of Suppliers

Leopold Elects Stuppy President

F. B. Leopold Co., Inc., Zelienople, Pa., has announced the election of M. L. Stuppy as president. He succeeds F. O. Leopold, president of the company for the past twenty-five years, who will continue to take an active part in the firm's operations as chairman of the board.

Mr. Stuppy joined Leopold six years ago and has been vice president since 1955.

Other officials elected at the company's recent board meeting are: Frank L. Davis, vice president; and C. R. Kennedy, secretary-treasurer.



WATER — AMERICA'S MOST VALUABLE RESOURCE

Water has become a Number 1 problem in the United States. Americans are using water at a greater consumption rate than any other people in history. With population increasing faster than any other nation, it is estimated that by 1975 there will be 227 million Americans—requiring 50% more water than they do today.

Of all our natural resources, water is the one most essential to human existence. Yet water has been one of the least emphasized for research and development. That task now is sponsored by 23 national associations, two of which are American Water Works Association and the Water & Sewage Works Manufacturers Association, Inc., through an agency called The Water Resources Council. It deserves your whole hearted support.

M&H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA
SUBSIDIARY OF W WALWORTH

Yeomans Names Norris Gen. Sales Mgr.

Yeomans Brothers Company, Melrose Park, Ill., has announced that Spaulding A. Norris has been named General Sales Manager of the Co., heading up the pump and sewage treatment divisions as well as the residential and industrial sales departments. Norris is an experienced mechanical and hydraulic engineer, having been associated with the industry for 21 years in the development, testing, application and sales engineering phases.

Mr. Norris joined the Yeomans organization in 1950 as assistant sales manager of the pump division. In 1952 he was made pump sales manager. A graduate civil engineer, he received his training at the University of Wisconsin, completing his studies in 1937.

Smith-Blair Inc. Opens Texas Plant

Smith-Blair, Inc., South San Francisco, Calif., has announced the opening of a new 6,000 square foot assembly plant, warehouse, and regional sales office. It will be located in Henderson, Texas. The new facilities will provide better service for users and jobbers of Smith-Blair pipeline couplings, connections, and clamps in the midwest, southern, and southwestern areas. Similar branch operations are located in Greensburg, Pa., and South Gate, Calif. These, together with the main office and factory, also serve and assist some 525 Smith-Blair jobbers throughout the United States.

Foxboro Names Huckman Asst. Field Sales Mgr.

The Foxboro Company, Foxboro, Mass., has announced the appointment of E. R. Huckman as assistant field sales manager. With field sales manager J. J. Burnett, Mr. Huckman will coordinate sales engineering activities of field personnel serving instrument users in the Northern and Eastern sales regions.

Although Mr. Huckman will continue as regional manager of the New York area, including sections of Con-

necticut, New Jersey and New York, his duties as manager of the New York City branch have been assumed by H. R. Cushman, formerly sales engineer at New York.

Mr. Huckman, a graduate of Massachusetts Institute of Technology with a B.S. degree in chemical engineering, joined Foxboro in 1927, working in the Instrument Service and Repair Department before assignment to the Tulsa office as sales engineer. In 1931 he moved to the St. Louis office and ten years later to New York where he served as assistant manager and later, manager.

Infilco to Distribute Hyla for Salem-Brosius

Salem-Brosius, Inc., Pittsburgh, Pa., has announced the appointment of INFILCO Incorporated, of Tucson, Arizona, as sole sales distributor of Hyla 603KM for use as a self-sanitizing de-chlorinating material. This distributorship will cover industrial, food processing, and beverage fields on a national basis.

Hyla 603KM is sold as part of water treating systems, and applied through equipment with no moving parts, no complicated controls, and very low maintenance.

Grace Appointed Sales Engineer for B-I-F Kansas City

B-I-F Industries, Inc., Providence, R. I., has announced that William J. Grace of Kansas City, Missouri, has been appointed a Sales Engineer for the Kansas City, Mo., office.

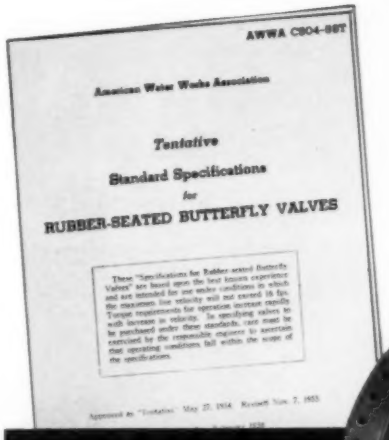
Mr. Grace received his B.S. degree in Industrial Engineering from the Illinois Institute of Technology, and did postgraduate work in Sales Management at the University of Chicago Business School. His experience includes service as a Maintenance Officer with the rank of 2nd Lt. in the U. S. Army Corps of Engineers, sales-work in the Chicago office of the Minnesota Mining and Manufacturing Co., and Sales Engineering for the Continental-Diamond Fibre Corp. of Kansas City.

American Well Forms Industrial Mixing Equip. Div.

The American Well Works, Aurora, Illinois, on its 90th Anniversary, has set up a special Industrial Mixing Equipment Division devoted to automated mixing processes.

Leading the line of this division's

Always **IN ALL WAYS**
Certified to Conform with AWWA Specifications


AWWA C504-56T
American Water Works Association
Tentative
Standard Specifications
for
RUBBER-SEATED BUTTERFLY VALVES

ROCKWELL Rubber-Seated BUTTERFLY VALVES

Made in full range of sizes, with rubber seat (as shown) or with spool type rubber liner; manual, electric, hydraulic or pneumatic operators.

Rockwell Rubber-Seated Butterfly Valves rank high in service among the successful valves installed in water works in recent years. They are always certified to meet ALL American Water Works Association requirements of design and construction in every detail for maximum shut-off pressures and line velocities under all operating conditions.

With Rockwell "AWWA" Valves you're sure of most efficient service at lowest maintenance cost. *Bulletin 574 tells you why.*

TYPICAL INSTALLATIONS IN
City of San Diego, Calif.
City of Seattle, Wash.
City of Ogden, Utah
City of Milwaukee, Wis.
City of Corpus Christi, Tex.
City of Miami, Fla.
City of Daytona Beach, Fla.
St. Lawrence Seaway
Panama Canal

W. S. ROCKWELL COMPANY
2828 ELIOT STREET • FAIRFIELD, CONN.
Sales Representatives in Principal Cities

specialized, cost-cutting equipment is the patented "American Homomix" which mixes fluids and gases automatically right in the pipeline, without use of mixing tanks.

Established in 1868, The American Well Works has pioneered many innovations in the pumping and treatment of water and wastes including the transport, mixing and processing of foods by single vane pumps through pipelines. Further developments of pipeline and tank mixing equipment by "American" engineers now make additional contributions to industrial efficiency.

Hagan Transfers Covode

Hagan Chemicals & Controls, Inc., Pittsburgh, Pa., has anonunced that after 18 years with the company's Cincinnati office, John H. Covode, Jr., has been transferred back to the Pittsburgh district sales office.

Mr. Covode, who has served both as a Hall Laboratories field engineer and a Hagan sales engineer, is a specialist in boiler instruments and controls and industrial water problems.

A native of Pittsburgh, Mr. Covode is a graduate of Grove City College and currently resides at 315 Spring Valley Road in the South Hills area of Pittsburgh.

Burnside Appointed Ludlow Sales Manager

Rutledge Retires

The Ludlow Valve Manufacturing Co., Inc., Troy, N. Y., has announced the appointment of Robert G. Burnside as sales manager to succeed Eric A. Rutledge who recently retired.

Mr. Burnside brings to Ludlow considerable experience in the industrial sales after serving with the Troy Belting Company, Troy, N. Y.; Cling Surface Company, Buffalo, N. Y.; and the Hancock Valve Division of Manning, Maxwell & Moore, Inc., Boston, Mass. He is a graduate of the school of business administration of Boston University.

Rutledge, widely known in the valve industry, enters retirement after nearly forty years of service in the waterworks field.

After joining in 1928 Rensselaer Valve Company he served as sales and research engineer, design consultant, vice-president and general manager, vice-president for sales and sales manager, and then became sales maanger for the Ludlow Valve Manufacturing Company, Inc. when the two companies merged in 1955.

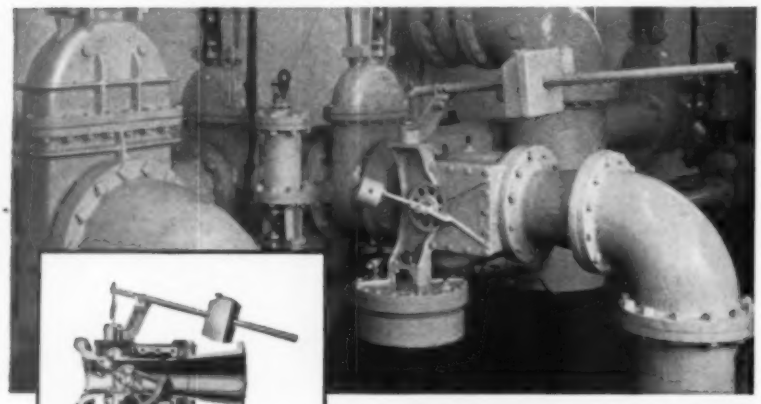
Mr. Rutledge was a member of the standardization committee of the Valve Manufacturers Association and maintained an active interest as company representative in the American Water Works Association.

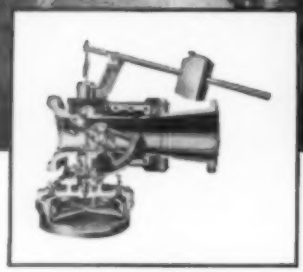
New Floatless Liquid Level Controls

Charles F. Warrick Co., Berkley, Mich., is producing a new line of 2 and 3 pole floatless, electrode type, liquid level controls which are listed by U/L and CSA and embody many desirable features not found in the controls which they supercede.

The controls are suitable for use in

POSITIVE CONTROL OF MATERIALS IN MOTION B-I-F





CONTROL FLOW WITH FLOW . . .

Builders Model RCE Rate-of-Flow Controller is Powered by the Flow it Controls!!

When other controllers stop . . . due to electrical power failure or interrupted air supply . . . the **reliable Model RCE** will continue to function! Another Builders progressive-design bonus!

In addition . . .

- **Costs less to install** . . . it just bolts into the line.
- **Permits flexible piping layouts** . . . compact . . . does not require long runs of straight pipe upstream or downstream . . . available in right-hand, left-hand, straight-through, or elbow types.
- **Costs less to maintain** . . . has ball bearings or knife edges at all friction points . . . plus packless construction.
- **Has lasting accuracy** . . . within ±3% over a control range of 25% to 100% of maximum capacity.
- **Available in 3" to 24" standard pipe sizes** . . . handles flows ranging from .04 to 36 mgd — for . . .

— controlling the effluent flow from a gravity sand filter.
— limiting flows to municipal subdivisions or industries.
— waterworks service (clear well level systems, filter level and master control systems).

Request Bulletin 600-G6A! Write Builders-Providence, Inc., 350 Harris Avenue, Providence 1, Rhode Island.

BUILDERS-PROVIDENCE
DIVISION OF
B-I-F INDUSTRIES
B-I-F METERS FEEDERS CONTROLS

conductive liquids, where the resistance does not exceed 20,000 ohms. They are energized from an alternating current source, draw 2 watts open circuited and less than 5 watts closed circuited, and are adaptable for electrical lockin or lockout.

All terminals are stud type and are situated on a single molded panel on the front of the control, providing extreme accessibility during the wiring operation. Each terminal is numbered for positive identification.

All contacts are of the double break, bridge type, and utilize ¼" diameter fine silver buttons. The moving contacts approach the stationary contacts on an arc, resulting in a modest wiping action. All contacts are oriented in the vertical plane to discourage the accumulation of foreign, airborne matter thereon.

Sparling Opens Denver Office

Sparling Meter Company, of El Monte, California, has just announced the formal opening of their Denver office under the management of Howard Hatfield, formerly associated with North American Aviation and Kim Lighting and Manufacturing Company.

This office will service Colorado, New Mexico, Wyoming and the western halves of North Dakota, South Dakota, and Nebraska. Mr. Hatfield's duties are to offer as much assistance as is possible to consulting engineers in the water works field with metering problems.

Mr. Hatfield, who personally opened the office on February 1, was graduated from the University of Southern California with a degree in Engineering. He is a member of Tau Beta Pi, honorary mechanical engineering society. The office is located at 1690 Milwaukee, Denver 6, Colo.

Armstrong to Head Western Office for Pratt

Henry Pratt Company, Chicago, Illinois, has announced the opening of a Western District Sales Office in Los Angeles, California. Named to head the office is Robert L. Armstrong, native of Los Angeles and a former practicing civil engineer in California and Arizona. Function of the new office will be to provide a more effective liaison with Pratt Sales Representatives in the eleven western states.

The office is located at: 3445 West 8th Street, Los Angeles, California.

Hardinge CLARIFIERS for circular tanks

Two Hardinge 100'-diameter, center-column final clarifiers at the municipal sewage disposal plant in York, Pennsylvania. (Albright and Friel, consultants)

Hardinge Clarifiers and Thickeners are being used in:

- SEWAGE TREATMENT PLANTS for primary and final clarification and sludge thickening.
- INDUSTRIAL WASTE TREATMENT of all types.
- WATER TREATMENT, industrial and public.

A wide selection of sizes and arrangements is offered:

- Normal duty and "Auto-Raise" heavy duty mechanisms.
- Beam, truss and center-pier supported units.
- Side feed and under feed.
- Spiral and segmented rakes.
- Mechanical, hydraulic or electrical overload protection.

Detailed specifications for all types and sizes are available upon request. Bulletin 35-D-15.

HARDINGE
COMPANY, INCORPORATED

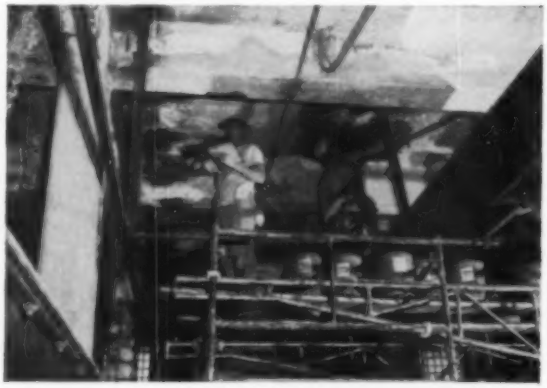
YORK, PENNSYLVANIA • 240 Arch St. • Main Office and Works

New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • San Francisco

How THORITE and THOROSEAL made this underground structure sound again!

Workmen prepare old surface for patching with THORITE.

Water has entered the concrete and caused corrosion of reinforcing rods, blistering the concrete off surface and causing structural weakness throughout building.



Reinforcing was cleaned, all corrosion was removed and brush coat of THORITE applied over entire patching area, then filled in with trowel coats of THORITE, even with surrounding surfaces.

THORITE Patching Mortar sets in 20 to 30 minutes and can be coated with THOROSEAL while hardening.

"How to do it" GET OUR 16 PAGE BROCHURE

STANDARD DRY WALL PRODUCTS, INC.
NEW EAGLE, PENNA. CENTERVILLE, IND.

New Bulletins

CONTINUED FROM PAGE 25A

Controlled Speed Systems

U. S. Electrical Motors, Inc., Los Angeles, Calif., has published a new illustrated booklet, "Controlled Speed Systems," which describes many typical installations for controlled automatic variable speed systems application.

The booklet provides information useful in determining preliminary planning and to obtain maximum efficiency in controlled speed systems operation.

Systems described in the booklet are applicable to basic handling processes such as mixing, filtering, conveying and proportioning, etc.

Proportioning Pumps

Hill-McCanna, Chicago, Ill., has just released a new two-color, eight-page catalog featuring Hills-McCanna Precision Proportioning Pumps.

This informative catalog covers the details and specification of the full line of proportioning pumps offered by Hills-McCanna Co. Maximum capacities of pumps covered range from 6cc/min to 730 gph per feed.

Zeolite Softeners

The General Filter Company, Ames, Iowa, has just published a new Zeolite Softener bulletin. It is a twelve-page publication, well illustrated and contains useful information for engineers and operators of water treating equipment. Several useful tables and charts are included.

Filter Operating Control Desk

Bailey Meter Co., Cleveland, Ohio, has published a new 2 page brochure that describes and illustrates three desk type control panels used in water treatment plants for operation of rapid sand filters.

Available in four standard colors, these sturdy control desks have inclined top surface for efficient operation. Dimensions and complete specifications are also included which is available on request.

Venturi Meter Tubes

526

Builders-Providence, Inc., division of B-I-F Industries, Inc., Providence, R. I., has available a comprehensive technical bulletin describing the various types of Venturi Tubes, their recovery characteristics, the formulae that determine their design, typical calculations, and similar data.

The bulletin includes a discussion of all aspects to be considered in Venturi design, vital installation instructions, the economics of Venturi metering, the various accessories available, and complete specifications. It is illustrated with diagrammatic sketches, comparison charts and graphs, installation drawings, dimensional data, and capacity tables.

Metering and Control Sytsems

527

Bailey Meter Co., Cleveland, Ohio, has published a new 4-page bulletin describing the purpose, design, and operation of Bailey Metering and Control Systems. A discussion of pneumatic and electrical telemetering, and pneumatic control is included, along with detailed literature references for all products making up these systems.

O-R-P Recording

528

Fischer & Porter Co., Hatboro, Pa., has available a catalog that describes O-R-P Cell and Potentiometer-Type Recorder for measuring, indicating and recording oxidation-reduction potential. It illustrates how electric, electronic or pneumatic control function may be added for automatic control of batch or continuous processes.

Digester Supernatant Corrector

529

Yeomans Bros. Co., Melrose Park, Ill., has available preliminary engineering data on a new method and apparatus for high pressure aero-oxidation of digester supernatant—the Presaire (R) Supernatant Corrector.

According to the data that were developed in conjunction with studies of Dr. H. O. Halvorson, the Presaire method prepares supernatant for return to primary or secondary treatment units by satisfying a goodly portion of the immediate oxygen demand. The apparatus and method also control odors traceable to hydrogen sulfide.

Another

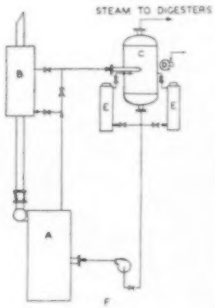
VAPOR PHASE®
INSTALLATION REPORT

COMPLETE VAPOR PHASE® Heat Recovery and Cooling Systems Designed and Furnished by Engineering Controls

San Jose Sewage Disposal Plant Reports . . .

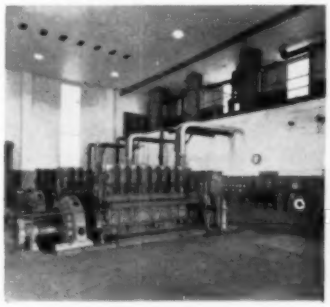
These Operating Advantages with VAPOR PHASE® on the Job:

- **Prevention of Corrosion** due to sulfur in sludge used as main fuel.
- **Estimated Fuel Economy of 4%.**
- **Constant Operating Temperature** regardless of load.
- **Less Wear** . No moisture condensation in engine cylinders because temperatures never drop below dew point of 194°F.
- **Dollar-Saving Heat Recovery** that provides (a) steam for digesters and (b) space heating for buildings.



A — Engine
B — One of 3 Exhaust Heat Recovery Silencers
C — Single Vapor Phase Separator
D — Make-up Valve
E — (2) 75 KW Electric Heaters
F — Water Pump

"Sole Developers and Manufacturers of Vapor Phase® Thermal Circulation (Ebullition) Engine Cooling Systems"



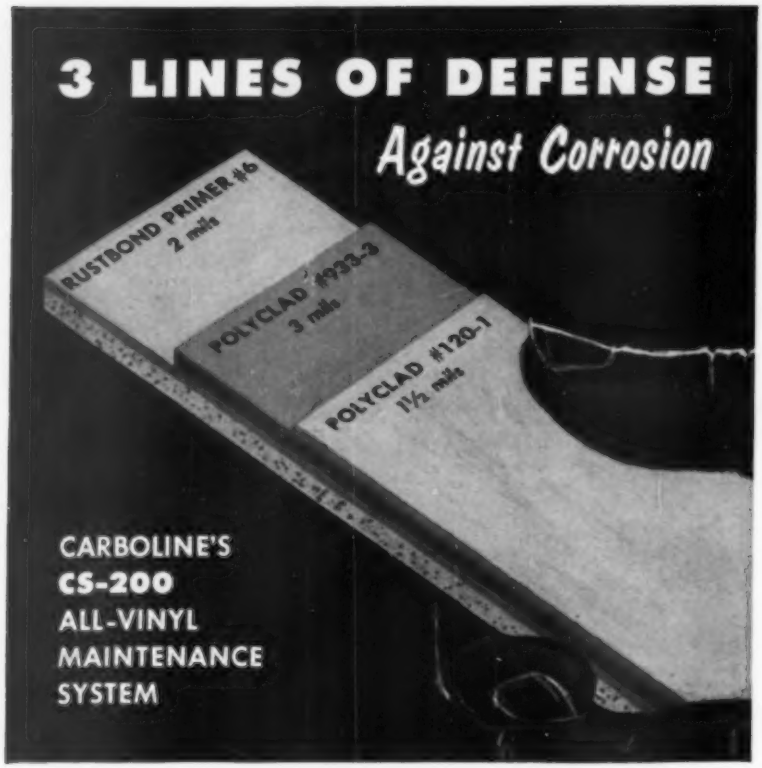
Mezzanine area shows space saving installation of Exhaust Heat Recovery Silencers, single Vapor Phase® Separator, and standby Electric Immersion Heater — all designed by Engineering Controls to service the three Enterprise 655 hp dual-fuel diesels.

E C VAPOR PHASE

ENGINEERING CONTROLS
Incorporated
AN AFFILIATE OF ST. LOUIS SHIPBUILDING & STEEL CO.

611 E. Marceaw
St. Louis 11, Mo.

1939 N. Hillhurst Ave.
Los Angeles 27, Calif.



For general maintenance work, corrosion authorities agree that 3 coats at 5 mils minimum thickness are essential for good protection and economy. Three coats, including a corrosion resistant primer, tend to eliminate porosities often found in heavy-thickness single coat systems.

Carboline's all-vinyl maintenance system has been service-proven to exceed these requirements and assure better chemical resistance to acids, alkalies, water and weathering.

The Carboline CS-200 system (6½-7 mils):

Rustbond Primer #6 good edge coverage, reduces undercutting, bonds tightly to wire brushed steel. Dries fast, speeds application.

Polyclad #933-3 an economical, high build intermediate coat formulated for better resistance to penetration than heavily filled vinyl mastics.

Polyclad #120-1 a tight seal coat with outstanding resistance to chemicals and weathering.

Use Carboline's Engineering Approach—compare solids content, coverage per gallon, mil feet per gallon, mil thickness per coat, resistance to corrosive, estimated recoating cycles, COST PER SQUARE FOOT PER YEAR OF SERVICE. It's the soundest method to determine the most effective, economical corrosion protection.

WRITE TODAY for bulletins and specifications on Carboline's CS-200 All-Vinyl Maintenance System. Also, request our precision wet film thickness gauge—no obligation.

carboline
COMPANY

32-N Hanley Industrial Ct.
St. Louis 17, Mo.

SALES OFFICES:
Boston, New York, Philadelphia, Pittsburgh, Detroit, Chicago, Houston, Denver, Los Angeles, San Francisco, Toronto, other leading cities.

Manufacturers of PHENOLINES and CARBOMASTICS

Helpful Bulletins

Available Free

Water & Sewage Gates

530

Armco Drainage & Metal Products, Inc., Middletown, Ohio, has available a new illustrated bulletin showing how their complete line of **Gates** meets municipal water and sewage control requirements.

Ductile Iron Valves

531

Kennedy Valve Mfg. Co., Elmira, N. Y., has just published a new bulletin describing in detail **Kennedy Ductile Iron Valves.**

Bronze Goods Catalog

532

Pubco Bronze, Los Angeles, Calif., has just released a new Bronze Goods Catalog covering their line of Corporation Stops, Service Stops, Curb Stops, Fittings and Valves.

Valve Sizing Charts

533

Jordan Corporation, Cincinnati, Ohio, has just published a 4-page bulletin on **Sizing Charts.**

Rotary Compressors

534

Davey Compressor Co., Kent, Ohio, has released a bulletin showing component parts of its new **Hydrovane Rotary Compressors.**

Rust Prevention Systems

535

L. Sonneborn Sons, Inc., Building Products Division, New York, N. Y., has available a four page brochure outlining applications and advantages of **The Sonneborn Rust Prevention System.**

Geared Flexible Couplings

536

Link-Belt Co., Chicago, Ill., has published a new book describing the company's complete line of improved **Geared Flexible Couplings.**

Primary Elements Catalog

537

Burgess-Manning Co., Penn Instruments Div., Philadelphia, Pa., has just published a 16-page Primary Elements Catalog #1, the first catalog of its kind.

SK's Instrument Division Products

538

Schutte and Koerting Company, Cornwells Heights, Pa., has announced the publication of Bulletin M-1, a condensed bulletin on Rotameters and Flow Instruments which pictures and briefly describes the division's line of precision instruments for measuring, indicating, recording, and controlling the rate of flow of all types of fluids.

Dual Valve Sludge Pumps

539

Komline-Sanderson Engineering Corp., Peapack, New Jersey, has just released a four-page bulletin on its Diaphragm and Plunger Type-Dual Valve Sludge Pumps.

Ball Joint Pipe

540

American Cast Iron Pipe Co., Birmingham, Ala., has just published a catalog on the American Molox Ball Joint Pipe.

Chemicals Used in Water, Sewage and Waste Treatment

541

Omega Machine Co., B-I-F Industries, Providence, R. I., has just released a revised, and up-to-date issue of their Technical Bulletin on Chemicals Used in Water, Sewage and Waste Treatment.

Pneumatic Sewage Ejectors

542

The Komline-Sanderson Engineering Corp., Peapack, New Jersey has just published a bulletin on its new Pneumatic Sewage Ejector.

Cut-In Valves

543

Golden-Anderson Valve Specialty Company, Pittsburgh, Pa., has just issued a new four-page bulletin describing their **Cushioned Emergency Cut-In Valve.**

boosts trench production 500%

SPRINGFIELD, N. J. contractors, Ern Construction Co., increased production more than 500% by replacing a backhoe with a Cleveland 110 on 11,000 feet of trenching for 8 and 12-inch pipe, digging 2 feet wide by 5½ feet deep.

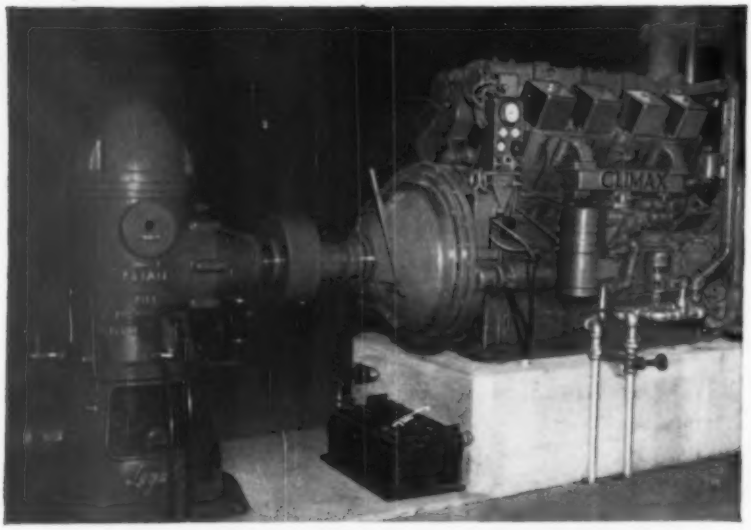
"The 110 got us 780 feet of trench per hour where we had been getting only 100-150 feet with the backhoe," reports Ern Foreman Henry J. Appleby. "Our operator got top production with the Cleveland after only 5 days experience at the controls. He was one of our regular work crew and had no previous training as a trencher operator."

Ern also saved 25% on his repaving costs with the narrow, clean accurate trench produced by his Cleveland 110.

The CLEVELAND TRENCHER Co.

20100 ST. CLAIR AVE. • CLEVELAND 17, OHIO

Good Everywhere ®



IMPORTANT FACTS ABOUT CLIMAX STANDBY ENGINES!!

CHOICE OF FUELS—
All models operate with equal efficiency on gas, butane or gasoline.

FAST, EASY STARTING—
Climax engines take over the complete load within seconds after normal utility power fails. If the starting system is manual, you merely press a button on the instrument panel...if automatic, the engine starts immediately.

SIMPLE TO OPERATE—
All instruments and controls are located at the sides of the engines . . . easy to read . . . easy to adjust.

SIMPLE TO MAINTAIN—
Accessories are within "arm's reach" to allow quick inspection and adjustment. Crankcases and engine bases have large hand holes on each side for easy access to all working parts.

SAFETY PROTECTED—
Safety devices are standard equipment on all models and automatically protect the engines against high water temperature and low oil pressure. An overspeed governor can also be furnished, if required.

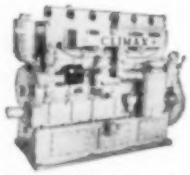
ACCESSORIES—
Various types of cooling and starting systems, mufflers, etc. are available to make each engine suitable for a particular application.

LONG ENGINE LIFE—
Climax engines are constructed of the finest metals, alloys and component parts available. Any model will give years of service if properly maintained.

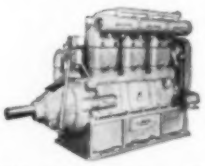
Write today for complete information, bulletins or engineering consultation

V-125—12 cylinder, 605 max. H.P. at 1200 R. P. M.
V-122—12 cylinder, 520 max. H.P. at 1200 R. P. M.

V-85—8 cylinder, 390 max. H.P. at 1200 R. P. M.
V-80—8 cylinder, 340 max. H.P. at 1200 R. P. M.



K-75—6 cylinder, 302 max. H.P. at 1200 R. P. M.
K-67—6 cylinder, 265 max. H.P. at 1200 R. P. M.



R-165—6 cylinder, 192 max. H.P. at 1200 R. P. M.

CLIMAX ENGINE MANUFACTURING CO.
DIVISION OF WAUKESHA MOTOR COMPANY
FACTORY – CLINTON, IOWA

Flocculation Equipment

544

Chain Belt Co., Milwaukee, Wis., has just published a new bulletin on Rex Flocculation equipment.

pH Equipment

545

Beckman Process Instruments Division, Fullerton, Calif., has announced the availability of a new eight-page brochure, "Beckman Industrial pH Equipment".

Blower-Compressor

546

Cyclo Blower Co., York, Pa., has just released a four page, 2-color, letterhead-size bulletin announcing the "CycloBlower", an axial-flow, positive-displacement blower for compression and vacuum service in a range from 85 to 3,342 cubic feet per minute.

All Transistor Amplifier

547

The Systems Division of **Beckman** Instruments, Inc., Fullerton, Calif. now has available on request, a four page brochure on the **Beckman All Transistor Amplifier.**

Thermometers

548

Minneapolis-Honeywell Regulator Co., Philadelphia, Pa., has released a catalog that describes the complete line of Brown rectangular case filled system thermometers. These indicators, recorders, transmitters, and electric or pneumatic control instruments are covered in detail in the new 56 page catalog.

Opportunity for

SANITARY ENGINEER
IN ROCHESTER, N. Y.

A Sanitary Engineer to supervise the maintenance and operation of Sewage Disposal Plants, Sewer Maintenance work and Incinerators and related work. Applicant must be a college graduate with B.S. degree with a major in Sanitary Engineering plus 10 years' experience in the field of Sanitary Engineering, 4 years of which has been in Sewage Plant operation. Applicant must be eligible for a New York State Engineer's license and a New York State Class "A" Sewage Operator's license. Salary Range, $8,550—$10,350. Apply by letter before June 15, 1958.

CIVIL SERVICE COMMISSION
242 WEST MAIN ST.
ROCHESTER, NEW YORK

Single-Home Sewage Treatment System

549

Yeomans Brothers Co., Melrose Park, Ill., has available a bulletin describing and illustrating the Cavitette, the single-home sewage treatment system.

Atomic Water Treatment

550

Hungerford & Terry, Inc., Clayton, N. J., has available for distribution a booklet called "Atomic Kilowatts".

Mixed Flow Pumps

551

Economy Pump Div., C. H. Wheeler Manufacturing Co., Philadelphia, Pa., has released a new twelve-page, 2-color catalog describing axial and mixed flow vertical and horizontal pumps.

Ring Balance Meters

552

Hagan Chemicals & Controls, Inc., Pittsburgh, Pa., has just released a new eight-page bulletin listing performance and specification data for series 3000 Ring Balance Meters and available accessories.

Weather Protected Motor

553

Allis-Chalmers, Milwaukee, Wis., just published a bulletin presenting the features which contribute to the outdoor dependability of A-C weather protected motors (Type FOD) built to NEMA and ASA standards in sizes NEMA frame 505 through 800 hp at 3600 rpm.

Instrument Accessories And Supplies

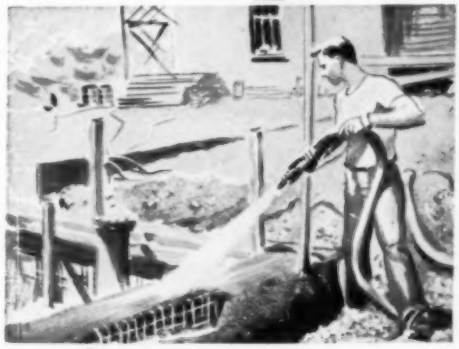
554

The Foxboro Company, Foxboro, Mass., has announced that complete information on industrial instrument **Accessories and Supplies** has been compiled in a new 60-page catalog, available to Foxboro Instrument users. The loose-leaf book, includes specifications, part numbers and prices for more than 250 commonly furnished instrument parts and supplies.

GUNITE does it **2** times as fast at **1/2** the cost

"Gunite" is the modern process (sand and cement applied pneumatically) for repairing, constructing, lining:

- Reservoirs
- Dams
- Filter Plants
- Sewage Disposal Plants
- Tanks
- Stadiums
- Bridges
- Sea Walls
- Swimming Pools, etc.



Write FOR MORE INFORMATION, INCLUDING 48 PAGE "GUNITE" BOOKLET.

PRESSURE Concrete Co.

FLORENCE, ALA. 1555 Helton Street

OTHER OFFICES IN

CHICAGO, ILL. 30 W. Washington Street

NEWARK 5, N. J. 193 Emmet Street

WANT MORE SPARKLE?

Let N-Sol activated silica (coagulant aid) help you to improve water quality. Highly colored or turbid waters sparkle like spring water with N-Sol. Its large, heavy, rapid-settling floc enmeshes more impurities.

Write for copy . . . "Jar Test Procedure for Activated Silica Sol".

PQ SOLUBLE SILICATES

N-Sol conveniently made in your plant from "N" sodium silicate and a reacting chemical.

PHILADELPHIA QUARTZ CO.
1166 Public Ledger Bldg., Philadelphia 6, Pa.

Trademarks Reg. U.S. Pat. Off.

SINGLE AND DOUBLE LID

METER BOX COVERS

for every Climate and Condition

Ford Meter Box Covers are made in sizes to fit on meter box barrels or tile from 15" to 36" diameter. They are made with several sizes of lid openings, with inset or overlapping lids, for sidewalk or lawn installations, for light or heavy traffic conditions. For really cold climates double-lid covers are recommended.

All are fitted with the Lifter Worm Lock that effects a tight fit, permits easy opening even when sealed with ice or dirt and makes it easy to lift the lid with the key.

Send for complete Ford Catalog No. 56. It describes Ford Covers and many other useful devices for more efficient metering of water services.

THE FORD METER BOX COMPANY, INC.

FOR BETTER WATER SERVICES

FORD

Wabash, Indiana

Cast Steel Gate Valves

555

Walworth Company, New York, N. Y., has released a new, four-page illustrated bulletin describing 150-lb and 300-lb cast steel gate valves.

The Story of Concrete Pressure Pipe

556

Price Brothers Co., Dayton, Ohio, has published a new and revised edition of the booklet "The Story of Concrete Pressure Pipe."

Buildings Savers Estimating Guide

557

Building Products Division, L. Sonneborn Sons, Inc., New York, N. Y., has available a four-page estimating guide, outlining uses and costs for 37 different "building saver" products.

Small Package Sewage Plant

558

Dorr-Oliver, Inc., Stamford, Conn., has announced the availability of a new, eight-page, two-color bulletin entitled, "The Dorr-Oliver Completreator." This bulletin describes the compact design, operation and advantages of this new package-type unit for small plants. Also included in the bulletin, are a line drawing, flow diagram and a series of photographs showing the step-by-step installation of a unit.

Induction Motors

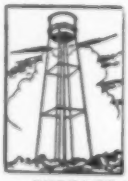
559

Electric Machinery Mfg. Co., Minneapolis, Minn., has available new condensed, two-page product sheets describing their line of Squirrel Cage Induction Motors. Both horizontal and vertical types are illustrated. The sheets are three-hole punched to easily fit in the three-ring binder.

Rotary Compressors

560

Kellogg Division, American Brake Shoe Co., New York, N. Y. has just published a brochure on new rotary air compressors.



Our Service Is A STIMULATING OPERATION Making Old Water Towers & Standpipes Look Like New Jobs

SURFACE MATERIALS THAT ARREST CORROSION

All guaranteed work

SPEELMON ELEVATED TANK SERVICE

Complete Painting & Repair Service

822 N. Court St. Rockford, Ill.

HELP WANTED

"We are looking for an energetic man with a capacity to take instruction and direct personnel, and to become assistant superintendent of our water and waste treatment plant. Must be qualified to make chemical analysis and do some research work on waste treatment. Some knowledge of biological organisms and their identification helpful."

Write:

Clifford Fore, Ass't. Treas.

Industrial Water Supply Company

P. O. Box 177, Mt. Vernon, Illinois

SALES ENGINEER

Graduate engineer, experienced in sanitary engineering and waste treatment equipment. Occasional travel, salary open; send resume.

RALPH B. CARTER CO.

192 Atlantic St., Hackensack, New Jersey

Consulting Engineers *IN WATER & SEWAGE WORKS*

ALBRIGHT & FRIEL INC.
Consulting Engineers
Water, Sewage, Industrial Wastes and Incineration Problems—City Planning, Highways, Bridges and Airports—Dams, Flood Control, Industrial Buildings—Investigations, Reports, Appraisals and Rates—Laboratory for Chemical & Bacteriological Analyses—Complete Service on Design and Supervision of Construction.
Three Penn Center Plaza
Philadelphia 2, Pa.

Bowe, Albertson & Associates
Engineers
Water and Sewage Works—Industrial Wastes—Refuse Disposal—Municipal Projects—Industrial Buildings—Reports—Plans—Specifications—Supervision of Construction and Operation—Valuations—Laboratory Service
75 West Street New York 6, New York

CAPITOL ENGINEERING CORPORATION
Engineers—Constructors—Management
SEWAGE SYSTEMS — Designs and Surveys, Planning, Bridges
WATER WORKS — Roads and Streets, Airports, Dams
Executive Offices
DILLSBURG, PENNSYLVANIA

Alvord, Burdick & Howson
Engineers
Water Works, Water Purification, Flood Relief, Sewerage, Sewage Disposal, Drainage, Appraisals, Power Generation
20 N. Wacker Drive, Chicago 6, Ill.

BOYLE ENGINEERING
Consulting Engineers
Water—Sewers—Streets
Structures—Surveys
Reports—Special Districts
331 Spurgeon Bldg. Santa Ana, Calif.
3913 Ohio, Rm. 200 San Diego 4, Calif.

The Chester Engineers
Water Supply and Purification—Sewage and Industrial Waste Treatment—Power Plants—Incineration—Gas Systems—Valuations—Rates—Management—Laboratory—City Planning
601 Seusmon Street
Pittsburgh 12, Penna.

JOHN J. BAFFA
Consulting Engineer
Water Supply and Treatment
Sewerage and Sewage Treatment
75 West Street New York 6, N. Y.

Brockway, Weber & Brockway Engineers
INCORPORATED
George S. Brockway — Roy E. Weber
George R. Brockway
STAFF
H. L. Fitzgerald, T. A. Clark, B. E. Whittington, R. E. Owen, John Adair, Jr., C. A. Anderson, T. R. Demery
Civil, Structural, Sanitary, Municipal, Electrical
West Palm Beach, Florida

Chas. W. Cole & Son
Engineers — Architects
Sewerage, Water Supply, Bridges, Highways, Toll Roads, Industrial, Municipal and Commercial Buildings
220 W. LaSalle Ave., South Bend, Indiana
Central 4-0127

MICHAEL BAKER, JR., INC.
The Baker Engineers
Civil Engineers, Planners, and Surveyors
Airports, Highways, Sewage Disposal Systems, Water Works Design and Operation—City Planning—Municipal Engineering—All types of Surveys
Home Office: Rochester, Pa.
Branch Offices:
Jackson, Miss. Harrisburg, Pa.

Buck, Seifert and Jost
Consulting Engineers
Water Supply, Sewage Disposal, Hydraulic Developments, Reports, Investigations, Valuations, Rates, Design Construction Operation Management, Chemical and Biological Laboratories
112 East 19th St. New York

CONSOER, TOWNSEND & ASSOCIATES
Water Supply, Sewerage, Flood Control & Drainage, Bridges, Express Highways, Paving, Power Plants, Appraisals, Reports Traffic Studies, Airports, Gas & Electric Transmission Lines.
360 East Grand Ave. Chicago 11, Ill.

Betz Laboratories, Inc.
CONSULTING ENGINEERS
INDUSTRIAL WASTE
INDUSTRIAL WATER
ANALYSIS, INVESTIGATIONS, DESIGN, OPERATION
Gillingham & Worth Sts.
Philadelphia 24, Pa.

BURGESS & NIPLE
Civil and Sanitary Engineers
Water Supply and Purification
Sewerage and Sewage Treatment
Appraisals, Reports, Valuations
2015 West Fifth Avenue
Columbus 12, Ohio

MR. CONSULTING ENGINEER
Are you interested in both
WATER & SEWAGE
If so there is no better place for your professional card than in this dual interest magazine.
Water & Sewage Works

BLACK & VEATCH
Consulting Engineers
Sewage—Waste Disposal—Water
Electricity—Industry
Reports, Design, Supervision of Construction, Investigations, Valuations and Rates
1500 Meadow Lake Parkway
Kansas City 14, Missouri

BURNS & McDONNELL
Engineers—Architects—Consultants
KANSAS CITY, MO.
P.O. Box 7088
Phone: DElmar 3-4375

DE LEUW, CATHER & COMPANY
Water Supply, Sewerage, Railroads, Highways, Grade Separations—Bridges—Subways, Local Transportation
Investigations—Reports—Appraisals
Plans and Supervision of Construction
150 North Wacker Drive Chicago
79 McAllister Street San Francisco 2, Calif.

BOGERT AND CHILDS
CONSULTING ENGINEERS
Clinton L. Bogert, Fred S. Childs
Ivan L. Bogert, Donald M. Ditmars
Robert A. Lincoln, Charles A. Manganaro
William Martin
Water & Sewage Works • Refuse Disposal Drainage • Flood Control • Highways and Bridges • Airfields
145 East 32nd Street, New York 16, N. Y.

Camp, Dresser & McKee
Consulting Engineers
6 Beacon Street, Boston 8, Mass.
Water Works and Water Treatment; Sewerage and Sewage Treatment; Municipal and Industrial Wastes; Investigations and Reports; Design and Supervision; Research and Development; Flood Control.

ROY B. EVERSON
Water Treatment Service Since 1900 for Swimming Pool Circulating Systems. Purification Systems as applied to Sewage Treatment and Water Works. A New System for Automatic Control.
233 W. Huron Street, Chicago 10, Ill.

Additional Engineers Cards on Next Page

FAY, SPOFFORD & THORNDIKE, Inc.
Engineers
Water Supply and Distribution—Drainage
Sewerage and Sewage Treatment
Airports—Bridges—Turnpikes
Port and Terminal Works—Industrial Bldgs.
Investigations, Reports, Designs, Valuations
Supervision of Construction
11 Beacon Street, Boston 8, Mass.

HAVENS AND EMERSON
W. L. HAVENS — A. A. BURGER
J. W. AVERY — H. H. MOSELEY
F. S. PALOCSAY — E. S. ORDWAY
F. C. TOLLES, CONSULTANT
CONSULTING ENGINEERS
WATER, SEWERAGE, GARBAGE, INDUSTRIAL WASTES VALUATIONS—LABORATORIES
LEADER BLDG., CLEVELAND 14, O. — WOOLWORTH BLDG., NEW YORK 7, N. Y.

LANNING
Sanitary Engineering Co., Inc.
Consulting Engineers
Professional Building
1100 South Broad Street
Trenton — New Jersey

FINKBEINER, PETTIS & STROUT
Carleton S. Finkbeiner — Charles E. Pettis
Harold K. Strout
CONSULTING ENGINEERS
Water Supply, Water Treatment, Sewerage, Sewage Treatment, Wastes Treatment, Bridges, Highways & Expressways
2130 Madison Avenue — Toledo 2, Ohio

Hayden, Harding & Buchanan, Inc.
Consulting Engineers
John L. Hayden
John H. Harding — Oscar J. Compto
Waterworks, Sewerage, Civil, Mechanical, Electrical, Structural
1340 Soldiers Field Road, Boston 35, Mass.

LOCKWOOD GREENE ENGINEERS, INC.
Architects - Engineers
Montgomery Building
SPARTANBURG, S. C.
Water Supply—Power Plants
Sewage Disposal—Valuations & Appraisals
Industrial Waste—Industrial Plant Design

Freese & Nichols
FORT WORTH, TEXAS
Freese, Nichols & Turner
HOUSTON, TEXAS
Industrial and Municipal Engineering—Water Supply and Purification—Sewerage and Industrial Waste Treatment—Highways and Structures—Dams—Drainage Works—Airports—Investigations—Valuation—Design and Supervision

HAZEN AND SAWYER
ENGINEERS
Richard Hazen — Alfred W. Sawyer
H. E. Hudson, Jr.
Water and Sewage Works
Industrial Waste Disposal
Drainage and Flood Control
122 East 42nd St., New York 17, N. Y. — 3333 Book Building, Detroit 26, Mich.

WM. S. LOZIER CO.
Sewerage, Sewage Disposal, Water Supply, Water Purification
Refuse Disposal
Consulting Engineers
10 Gibbs Street — Rochester 4, N. Y.

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Engineers
HARRISBURG, PA.
Pittsburgh, Pa. — Daytona Beach, Fla.
Philadelphia, Pa.
Water Works, Sewage, Industrial Wastes and Garbage Disposal—Roads, Airports, and Garbage Disposal—Roads, Airports, Bridges, Flood Control, Traffic & Parking, Appraisals, Investigations & Reports.

HENNINGSON, DURHAM & RICHARDSON
Consulting Engineers since 1917 for more than 700 cities and towns.
Water Works, Light and Power, Sewers, Sewage Treatment, Reports, Flood Control, Appraisals, Drainage, Paving.
2962 Harney St., Omaha 2, Nebraska

Metcalf & Eddy
Engineers
Water, Sewage, Drainage, Refuse and Industrial Waste Problems
Airports — Valuations
Laboratory
Statler Building, Boston 16

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Water Supply and Purification
Sewage and Industrial Waste Treatment
Chemical Laboratory Service
Investigations and Reports
New York — Reading, Pa. — Washington
Houston — Philadelphia

The Jennings-Lawrence Co.
Civil & Municipal Engineers
Consultants
Water Supply, Treatment & Distribution
Sewers & Sewage Treatment
Reports—Design—Construction
1392 King Ave. — Columbus 12, Ohio

Nussbaumer, Clarke & Velzy, Inc.
Newell L. Nussbaumer—Irving Clarke—Charles R. Velzy
Water Supply and Treatment
Sewerage & Sewage Disposal
Garbage Incineration
Municipal Planning
500 Fifth Avenue, New York 36, N. Y.
327 Franklin St. — Buffalo, N. Y.

GLACE AND GLACE
Consulting Sanitary Engineers
WATER SUPPLY AND PURIFICATION
SEWERAGE AND SEWAGE TREATMENT
Design, Construction and Supervision of Operation
2771 Paxton Street — Harrisburg, Pa.

Jones, Henry & Williams
Consulting Sanitary Engineers
Water Works
Sewerage & Treatment
Waste Disposal
821 Security Bldg. — Toledo 4, Ohio

O'BRIEN & GERE
Consulting Engineers
Water Supply, Treatment and Distribution
Sewerage and Sewage Treatment
Industrial Waste Treatment—Flood Control and Drainage—Rate Studies
400 East Genesee Street — Syracuse 2, N. Y.

GREELEY AND HANSEN
Engineers
Samuel A. Greeley — Paul Hansen (1920-1944)
Paul E. Langdon — Kenneth V. Hill
Thomas M. Niles — Samuel M. Clarke
Water Supply, Water Purification
Sewerage, Sewage Treatment
Flood Control, Drainage, Refuse Disposal
220 S. State Street, Chicago 4

Engineering Office of CLYDE C. KENNEDY
SANITARY ENGINEERING
SAN FRANCISCO

PARSONS, BRINCKERHOFF HALL & MACDONALD
G. Gale Dixon, Associate
Civil and Sanitary Engineers
Water, Sewage, Drainage and Industrial Waste Problems.
Structures—Power—Transportation
165 Broadway — New York 6, N. Y.

HASKINS, RIDDLE & SHARP
Consulting Engineers
Water—Sewage & Industrial Wastes—Hydraulics
Reports, Design, Supervision of Construction
Appraisals, Valuations, Rate Studies
1009 Baltimore Ave. — Kansas City 5, Mo.

Morris Knowles, Inc.
Engineers
Water Supply and Purification, Sewerage and Sewage Disposal Valuations, Laboratory, City Planning
1312 Park Building, Pittsburgh, Pa.

MALCOLM PIRNIE ENGINEERS
Malcolm Pirnie — Ernest W. Whitlock
Robert D. Mitchell — Carl A. Arenander
Malcolm Pirnie, Jr.
MUNICIPAL AND INDUSTRIAL
Water Supply—Water Treatment
Sewage and Waste Treatment
Drainage—Sewerage—Refuse Disposal
25 West 43rd St. — New York 36, N. Y.

Additional Engineers Cards on Next Page

THE PITOMETER ASSOCIATES, INC.
Engineers
Water Waste Surveys
Trunk Main Surveys
Water Distribution Studies
Water Measurements & Special Hydraulic Investigations
New York. 50 Church Street

J. E. SIRRINE Company
Engineers
Water Supply & Purification
Sewage & Industrial Waste Disposal
Stream Pollution Reports
Utilities, Analyses
Greenville South Carolina

MR. CONSULTING ENGINEER
Are you interested in both
WATER & SEWAGE
If so there is no better place for your professional card than in this dual interest magazine.
Water & Sewage Works

LEE T. PURCELL
Consulting Engineers
Water Supply & Purification; Sewerage & Sewage Disposal; Industrial Wastes; Investigations & Reports; Design; Supervision of Construction & Operation
Analytical Laboratories
36 De Grasse Street Paterson 1, N. J.

Benjamin L. Smith & Associates
Engineers
Investigations—Reports
Designs—Supervision—Valuations
Municipal Engineering and Public Utilities
11 North Pearl Street
Albany 7, New York

Weston & Sampson
Water Supply, Water Purification, Sewerage, Sewage and Industrial Waste Treatment, Corrosion Control, Laboratory Service Supervision, Valuations
14 Beacon St. Boston, Mass.

Thomas M. Riddick
Consulting Engineer and Chemist
Municipal and Industrial Water Purification, Sewage Treatment, Plant Supervision, Stream Pollution Investigations, Chemical and Bacteriological Analyses.
389 East 149th Street
New York 55, N. Y.

STANLEY ENGINEERING COMPANY
Consulting Engineers
Hershey Building 208 S. LaSalle St.
Muscatine, Iowa Chicago 4, Ill.

Whitman & Howard
Engineers (Est. 1869)
Water Supply, Water Purification, Sewerage, Sewage Disposal, Water Front Improvements and all Municipal and Industrial Development Problems, Investigations, Reports, Designs, Supervision, Valuations.
89 Broad St., Boston, Mass.

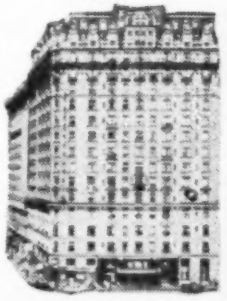
ROBERT AND COMPANY
ASSOCIATES
Engineering Division
ATLANTA

Alden E. Stilson & Associates
Limited
Consulting Engineers
Water Supply—Sewage—Waste Disposal
Bridges—Highways—Industrial Buildings
Studies—Surveys—Reports
2060 E. 9th Street, Cleveland 15, Ohio

WHITMAN, REQUARDT & ASSOCIATES
Engineers—Consultants
Civil—Sanitary—Structural—Mechanical—Electrical
Reports, Plans, Supervision, Appraisals
1304 St. Paul Street
Baltimore 2, Maryland

THE Martinique
THE NEW LOOK IN NEW YORK

Sparkling new interiors—superb new furnishings—striking new decor!
Ideally located in the great Penn Zone Times Square, Radio City, Rockefeller Plaza, theater district, and famous Fifth Avenue shops less than 5 minutes away. Lobby connects with Penn Railroad and Greyhound Bus terminals, and Hudson-Manhattan Tubes to Jersey.
650 luxurious rooms—radio, television, air-conditioning available. All hotel services.



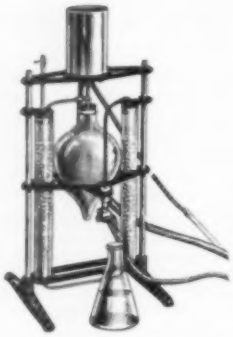
from $5 single $8.50 double
CONVENTION FACILITIES
NEW MARTINIQUE LOUNGE COFFEE SHOP
BROADWAY AT 32nd STREET **New York City**
Telephone PEnnsylvania 6-3800

Tops in Everything
ONVENIENT

Ideally located in St. Louis, two short blocks from the Union Station and in the center of the Wholesale District . . . Preferred, always by experienced travelers because of its outstanding advantages— Every room with combination tub and shower . . . and circulating ice water.
Delicious food . . . cheerful service.
AIR-CONDITIONED ROOMS
350 rooms from $3.50
HOTEL **LARIDGE**
ERNIE SIMONS General Manager
LOCUST ST. AT EIGHTEENTH
Free Parking
ST. LOUIS

ENSLOW

STABILITY INDICATOR



For checking the equilibrium of a finished water, and supplying an index useful in controlling anti-corrosion treatment. Catalog No. 83-895

WRITE:

Phipps & Bird, Inc.

P. O. Box 2V Richmond 5, Va.

The Heart of fine WATER PURIFICATION

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

SYSTEMS

Roberts Mechanical Equipment

ROBERTS FILTER Mfg. Co.

607 COLUMBIA AVE. DARBY, PA.

Advertisers Index

B

Badger Meter Mfg. Co. ..... Back Cover
*Bailey Meter Co. 32A
*B-I-F Industries, Inc. 14A-15A-106A
Buffalo Meter Co. 47A
*Builders-Providence, Inc. 14A-15A-106A
Byers Co., A. M. 48A

C

Calgon 30A
Carboline Co. 110A
Carborundum Co. 50A
Cast Iron Pipe Research Ass'n 36A-37A
*Chain Belt Co. 12A
*Chicago Bridge & Iron Co. 40A
*Chicago Pump Co. 97A
*Cleveland Trencher Co. 111A
Climax Engine Co. 112A
*Clow & Sons, James B. 31A
Consulting Engineers 115A-116A-117A

D

Darling Valve & Mfg. Co. 26A
Dixie Tank & Bridge Co. 101A
*Dorr-Oliver ..... Third Cover

E

Eddy Valve Co. 43A
Ellis & Ford Mfg. Co. 13A
Engineering Controls, Inc. 109A

F

Fairbanks-Morse Co. 46A
*Fischer & Porter Co. 2A
Ford Meter Box Co. 114A
Foxboro Co., The 10A

G

General Services Co. 42A
*Graver Tank & Mfg. Co. 21A-22A

H

*Hardinge Company, Inc. 107A
Healy-Ruff Company 27A
Hersey Manufacturing Company 49A
Homestead Valve Mfg. Co. 45A
Hotel Martinique 117A
Hotel Claridge 117A
Hydraulic Development Corp. 27A

I

*Infilco Inc. 38A

L

Leopold & Co., F. B. 11A
Leupold & Stevens Instr. Co. 101A
*Link Belt Co. 29A
Lock Joint Pipe Company ..... Second Cover
*Ludlow Valve Mfg. Co. Inc. 51A

M

*M & H Valve & Fittings Co. 104A
Minneapolis-Honeywell Reg. Co. 16A
Mueller Co. 17A-18A-19A-20A
*Multiplex Mfg. Co. 5A

N

*National Clay Pipe Mfrs. 44A
*Neptune Meter Company 52A

O

*Olin Mathieson Chemical Co. 102A
Oliver Corp. 34A

P

*Pacific Flush Tank Co. 6A
*Permutit Co. 1A
Philadelphia Quartz Co. 113A
*Phipps & Bird, Inc. 118A
Photovolt Corp. 98A
*Pratt Co., Henry 4A
*Pressure Concrete Co. 113A

R

*Roberts Filter Co. 118A
Rockwell Co., W. S. 105A

S

Simplex Valve & Meter Co. 33A
*Smith Co., A. P. 35A
*Smith Co., S. Morgan 28A
Speelman Elevated Tank Services 114A
Standard Dry Wall Products, Inc. 108A
Syncho-Start Products, Inc. 98A

T

*Tennessee Corp. 25A

U

U. S. Electrical Motors, Inc. 23A
U. S. Rubber 8A

W

*Washington Aluminum Co. 100A
*Walker Process Equipment, Inc. 24A
*Wallace & Tiernan, Inc. 103A
Wood Co., R. D. 41A

Y

*Yeomans Bros. Co. 99A

Z

Zimmer & Francescon 13A

*Advertisers represented in the 1957 Reference and Data Number with Catalog specifications copy. Please refer to that issue for additional information concerning their product or equipment.

IT'S NEW / It's from DORR-OLIVER

THE COMPLETREATOR

This D-O CompleTreator unit is serving a recreational facility at Freestone Point, Virginia.

Now . . . for the first time . . . complete sewage treatment for a population equivalent of 150 persons *in a single unit*. The CompleTreator unit consists of a Dorr Duo-Clarigester surrounded by two stages of high rate trickling filters and two recirculation pumps in respective wells. Solidly based on well-known and proven sanitary engineering principles and methods, the CompleTreator has the outstanding advantage of incorporating in a single unit those processes which previously required five separate tanks. Using the two-stage Biofiltration flowsheet with separate sludge digestion, average daily capacity is 15,000 gallons; and where normal domestic sewage is being handled, a treatment efficiency of 90% BOD and suspended solids removal can be realized. The CompleTreator is ideally suited for housing developments, restaurants, service stations, motels, schools, military installations and domestic type wastes from industrial activities.

For additional information on the Dorr-Oliver CompleTreator, write Dorr-Oliver Incorporated, Stamford, Conn., for a copy of Bulletin No. 7315.

CompleTreator is a Trademark of Dorr-Oliver Incorporated

DORR-OLIVER
INCORPORATED
WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT
STAMFORD • CONNECTICUT • U. S. A.

CASE HISTORY: How Badger PRP* helps communities meet rising costs without raising rates.

* ***Planned Rehabilitation Program helps city***

account for 94% of water used

through annual "roundup" of defective meters

A near impossible record — but this Midwestern city did it! The community (name on request) began metering when it started its water system back in 1882. One of the nation's first cities to be fully metered, it initiated a planned meter rehabilitation program at the outset. Result: low water waste, high water revenue — as much as 94% of *all* the water used is "accounted for."

Badger's Planned Rehabilitation Program has helped communities all over the country keep their water systems on this same profitable basis. They're installing new, accurate Badger meters where it is economically feasible... new essential parts where only minor repairs are needed.

Is your water department paying its way?

If not, it's time your community held its own water meter roundup — to open the way to new revenue . . . end water waste from worn-out meters and parts . . . even help meet rising water department costs. Send for free booklet, "Take 5," outlining the 5 steps to increased revenue through Badger's Planned Rehabilitation Program.

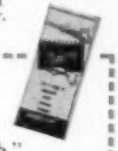
And be sure to ask your Badger representative about our liberal water meter trade-in policy.

Badger Water Meters

BADGER METER MFG. CO. • 4545 W. Brown Deer Rd.
Milwaukee 18, Wisconsin

Research makes the big difference in meters Badger builds...

New features for water meters are constantly being developed and tested in Badger's engineering and research departments. Here a chemist inspects plastic specimens tested for dimensional stability. To his right, a test of registers operating under water determines corrosion resistance . . . and an electrolytic analyzer is making a quantitative analysis. From these tests and others will come still greater efficiency and proven durability for future water meters—first from Badger.



BADGER METER MFG. CO.
Dept. C-1, 4545 W. Brown Deer Rd.
Milwaukee 18, Wisconsin

Gentlemen:
Please send me your free booklet, "Take 5."

Name_____

Title_____

Address_____

City_____ State_____